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SELECTIONS

FROM

EMBRYOLOGICAL MONOGRAPHS.

COMPILED BY

ALEXANDER AGASSIZ,
WALTER FAXON, AND E. L. MARK.

III.

ACALEPHS, AND POLYPS,

By J. WALTER FEWKES; By E. L. MARK.

WITH THIRTEEN PLATES.

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NOTICE.

The present number of the Memoirs of the Museum forms the third Part of the Plates accompanying the Selections from Embryological Monographs.

Part I.	Crustacea, by Walter Faxon . . .	Mem. M. C. Z., IX. No. 1
" II.	Echinodermata, by Alexander Agassiz . .	" " " 2
" III.	Acalephs, by J. Walter Fewkes; Polyps, by E L. Mark	" " " 3

The Bibliography thus far published consists of: —

I.	Crustacea, by Walter Faxon . . .	Bull. M. C. Z., IX. No. 6
II.	Echinodermata, by Alexander Agassiz .	" " X. " 2
III.	Acalephs, by J. Walter Fewkes . . .	" " XI. " 10

Other Parts of the Bibliography and of the Plates are in preparation.

ALEXANDER AGASSIZ.

Museum of Comparative Zoölogy,
Cambridge, Mass., U. S. A.

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TABLE OF CONTENTS.

[1] Figures 45 and 16 were interchanged by the lithographer.

REFERENCES TO THE PRINCIPAL PHASES OF DEVELOPMENT IN HYDROZOA AND CTENOPHORA.

For a comparison of the earliest stages of development from the ovum to the morula, see *the Segmentation of the Egg* on

Plate I. figs. 1–6, Plate II. fig. 1, Plate III. figs. 13^a, 13^f, 15, 19–21, for the Hydroida (Hydra, Coryne, Laomedea, and Eucope).
Plate IV. figs. 1–4, 21–30, for the Trachymedusæ (Polyxenia and Geryonia).
Plate VIII. figs. 1–8, for the Acraspeda (Aurelia).
Plate IX. figs. 1–7, 9–13, 14–19, for the Ctenophora (Beroë and Pleurobrachia).

For the formation of the *Blastula* and *Gastrula*, see

Plate I. figs. 7–11, Plate III. figs. 14^g–14^k, 20–25, for the Hydroida (Hydra, Eucope, and Laomedea).
Plate IV. figs. 5–7, 31–34, for the Trachymedusæ (Polyxenia and Geryonia).
Plate VI. figs. 10, 20, Plate VII. figs. 1–5, for the Siphonophora (Epibulia, Physophora, and Agalma).
Plate VIII. figs. 9, 10, 11–23, for the Acraspeda (Aurelia).

For the development of the *Larva when Sessile*, see

Plate V. figs. 24^a–24^d, for the hydroid formed from a free frustule (Schizocladium).
Plate III. figs. 6–11, 12^a–12^e, 17, 18, for the development of the hydranth (Clytia and Laomedea).
Plate V. figs. 25^a–25^c, for the development of the Corbula (Aglaophenia).
Plate VIII. figs. 24–39, Plate V. fig. 23 (Aurelia and Lucernaria).

For the development of the *Bud which becomes a Gonophore*, see

Plate I. figs. 1–6, 12–14 (Hydra and Myriothela).
Plate II. figs. 2–11, 14–21 (Coryne and Hybocodon).
Plate III. figs. 1–4, 15, 16, 26 (Obelia, Laomedea, and Tubularia).
Plate III. figs. 7–19, Plate V. figs. 20–22 (Cunina and Lizzia).

For the *Free swimming Larva developed from the Bud*, see

Plate I. figs. 20–22, Actinula (Myriothela).
Plate II. figs. 12, 13, 22, 23 (Sarsia).
Plate III. figs. 5, 5^a (Obelia). Plate III. figs. 27–30, Plate V. fig. 10, Actinula (Tubularia).
Plate IV. figs. 16–20, 35, 36 (Cunina and Geryonia).
Plate V. figs. 8, 9, Sporosac (Dicoryne); fig. 11, Ambulatory medusa (Clavatella); figs. 12, 14, 15, 16, 17, 18, 19 (Perigonimus, Bougainvillia, Oceania, Zygodactyla, and Willia).
Plate VI. figs. 8, 9 (Porpita, Velella).
Plate VIII. figs. 40–49, Plate V. fig. 26, for the Ephyra (Aurelia).

For the development of the *External Outlines of Larvæ which are never sessile*, see

Plate IV. figs. 7–10, 16, 20, 34–36 (Polyxenia, Cunina, and Geryonia). Plate V. figs. 1–7, 26 (Glossocodon and Cyanea).
Plate VI. figs. 2–7, for the Discoidea (Velella and Porpita), Plate VII. figs. 1–29, Plate VI. figs. 1, 10–31, for the Siphonophora (Physalia, Epibulia, Gleba, Halistemma, Agalmopsis, Agalma, Physophora, Praya, Diplophysa, Diphyes, and Muggiæa).
Plate IX. figs. 24–50, for the Ctenophora (Beroë, Chiaja, Callianira, Hormiphora, Pleurobrachia), Plate X. figs. 1–20 (Beroë, Cestus, Chiaja, Lampetia, Ocyroë).

REFERENCES TO THE PRINCIPAL PHASES OF DEVELOPMENT IN ANTHOZOA.

Segmentation.

PLATE XIII. 58, 59, and PLATE XII. 37, 38, for Alcyonium digitatum.
" XIII. 43, for Gorgonia verrucosa.

Blastosphere (in section).

PLATE XI. 26, for Actinia mesembranthemum.
" XII. 1, " Cerianthus membranaceus.

Gastrula.

PLATE XI. 27, 28, for Actinia mesembranthemum.
" XII. 2, 3, " Cerianthus membranaceus.

Free-swimming larva.

PLATE XI. 5–23, for Actinia mesembranthemum.
" XII. 3–15, " Cerianthus membranaceus.
" " 16–20, 26, 34–36, for Edwardsia.
" " 39, for Alcyonium digitatum.
" XIII. 1–6, " Astroides calycularis.
" " 12, " Balanophyllia regia.
" " 16, " Gorgonia verrucosa.
" " 29–31, " Corallium rubrum.
" " 45, " Astraea sp. ?
" " 47, " Renilla reniformis.

Mesenteries and mesenterial filaments.

PLATE XI. 5–25, for Actinia mesembranthemum.
" " 29–31, " Actinia sp. ?
" " 33, " Actinia equina.
" " 35, 36, " Adamsia diaphana.
" " 37, H'. J'. K'. Aiptasia lacerata. (New mesenteries in the offshoot.)
" XII. 5, 8, 9, for Cerianthus membranaceus.
" " 16, 18, 20, 22, 23, 27–36, for Edwardsia.
" " 41–43, for Alcyonium digitatum.
" XIII. 2–5, 19, 20, for Astroides calycularis.
" " 15, for Balanophyllia regia.
" " 17, " Astraea sp. ?
" " 47–52, " Renilla reniformis.

Tentacles.

PLATE XI. 20–25, for Actinia mesembranthemum.
" XII. 5, 6, 12–15, for Cerianthus membranaceus.
" " 16–23, 26, 33, for Edwardsia.
" XIII. 4, 10, for Astroides calycularis.

The corallum.

PLATE XIII. 8, 10, 11, 18–28, for Astroides calycularis.
" " 38, 41, for Corallium rubrum.
" " 46, " Gorgonia verrucosa.

Scissiparity.

PLATE XI. 37, for Aiptasia lacerata.

EMBRYOLOGICAL MONOGRAPHS.

PLATE I.

Development of the HYDROIDA. *Figures from* NICOLAUS KLEINENBERG *and* GEORGE J. ALLMAN.

C. c a v. Cavity of the planula.
c p. "Structureless capsule."
E. e b. Epiblast.
e b'. Epiblastic prominence.
e x. s. External pellicle, or perisarc.
G. g a. Gastric cavity.
H. h b. Hypoblast.
h b'. Hypoblastic elevation under the epiblastic.
I. i. Internal pellicle, or perisarc.
M. m b. Membrane.
N. n l. Nucleus (?).
O. o m. Ovum.
o r'. Thin region of walls at one pole where a mouth is later formed.
T. t a. Permanent tentacular processes.
t a'. Provisional tentacular appendages.
ζ. Sucker-disk at "proximal" extremity.
η. Situation of mouth at "distal" extremity.
θ. Cellular bodies surrounding the ovum.
λ. Orifice formed by an invagination of a tentacular process (*t a'*).
μ. Chamber filled with "granular protoplasm."
ο. Diverticulum from the cavity of the blastostyle from which the heruia-like bud forms.
ω. Highly refractile body.

1–11. Development of *Hydra*, from Kleinenberg, Hydra. Eine Anatomish — Entwicklungsgeschichtliche Untersuchung. Pl. II., Figs. 10, 11, 16, 17, 18, 19; Pl. III., Figs. 11, 12, 13, 14, 15.

1. Ovum of *H. aurantiaca* in amœboid condition, with chlorophyll granules and yolk spherules (pseudocells). The large cell in the center of the figure is the germinative vesicle. "Der Keimfleck des Keimbläschen ist in der Fig. nicht zu sehen, war aber noch vorhanden," Kleinenberg. The processes thrown out in all directions are protoplasmic. The yolk cells are formed from the protoplasm.
2. Germinative vesicle liberated from the enveloping substance. *m b.* Membrane. *n l.* Germinative dot. *ω.* Refractile body in the germinative dot.
3. Ovum shortly before the rupture of the surrounding cells (*θ*). *o m.* Ovum.
4. Segmented ovum with two spheres.
5. Still older ovum, with four spheres. No segmentation cavity is formed.
6. Morula.
7. Section through the germinative vesicle of *H. viridis*. *e x. s.* External pellicle. *g a.* Body cavity. *i. s.* Internal pellicle.
   There is a layer of cells surrounding the body cavity inside the internal pellicle. The external pellicle (perisarc of marine hydroid ?) is ultimately lost; the internal is absorbed.
8. Embryo of *H. aurantiaca*. *e b.* Epiblast. *h b.* Hypoblast. *i. s.* Internal pellicle. The external pellicle is ruptured and thrown off. The caudate cells ("nerve-muscular") form in the outer layer (*e b*). The inner layer (*h b*) in this stage becomes cellular.
9. Embryo of last-named species, seen in plane of longer axis. The future mouth opens near *o r'*. *e b.* Epiblast. *h b.* Hypoblast. *i. s.* Internal pellicle.
10. The same with the walls of the two poles similar. *e b.* Epiblast. *h b.* Hypoblast. *i. s.* Internal pellicle.

11. Embryo after the formation of the mouth. A small cluster of cells, not represented in the figure, is represented in Kleinenberg's figure just above the mouth. The tentacles appear in pairs, as hollow processes.

12–22. Development of *Candelabrum phrygium*, De Blain. *Myriothela phrygia*, Fab.). From Allman, On the Structure and Development of Myriothela. Phil. Trans. Roy. Soc. CLXV., Pl. LVII., figs. 1, 2, 3, 4; Pl. LVIII., figs. 1, 2, 4, 5, 6, 7, 8.

12. Very young bud, which later forms a gonophore. *c b*. Epiblast forming a slight elevation. *h b'*. Accompanying hypoblastic prolongation into the epiblastic prominence. μ. Cavity filled with granular protoplasm. σ. Diverticulum from the chamber or cavity of the blastostyle.
13. "More advanced stage (female); the gonophore has formed a very decided projection from the external surface of the blastostyle, and the gonogenetic chamber (μ) has begun to show a differentiation in its contents." Allman. *c b'*. Epiblastic prominence above the surface of the blastostyle. *h b*. Hypoblastic layer. μ. Gonogenetic chamber. σ. Diverticulum from the cavity of the blastostyle.
14. The female gonophore still more developed. *mb*. Membrane. μ. Gonogenetic chamber. σ. Diverticulum from the cavity of the blastostyle.
15. A gonophore older than the last.
    The wall of the gonophore in a stage of the same, older than figure 15, is ruptured, and the contents escape. It (the portion escaping) is, however, grasped by a peculiar clasper, which holds fast to its capsule by a sucker-like body, and certain changes take place while it is in this embrace.
16. Planula. A segmentation about which there is little known has taken place, and the planula has an outer layer (*c b*), an inner layer (*h b*), while a cavity (*cav.*) has been formed by the liquefaction of the central part of the mass. It is enveloped in a membrane (*mb*), and enclosed in a capsule, which is firmly held by the claspers. There are *no* cilia.
17. Embryo with minute pits (λ) forming the orifices of invaginations of the wall of the planula, and enclosed in a capsule (*cp*). These invaginations are composed of two layers, and later, when reversed, form the provisional appendages (*ta'*).
18. Embryo still enclosed in a capsule and held by the claspers, both of which structures are not represented. The invaginated appendages (*ta'*) have been turned outward.
19. Embryo taken from a capsule in which small papillæ have begun to form at one end. These (*ta*) later elongate into the permanent tentacles. *ta'*. Provisional appendages.
20. Embryo free from the capsule, which has begun to fasten itself at one extremity by a disk (ζ). η. Position of the mouth. *ta*. Permanent tentacles. *ta'*. Transitory arms.
21. The larva permanently fastened, possessing permanent arms (*ta*), but destitute of transitory appendages.
22. Free, locomotive embryo (actinula), just after its escape from the capsule, and younger than the earliest attached condition (20). *ta*. Permanent arms. *ta'*. Transitory arms. ζ. Disk for fixation. η. Mouth region. The arms are represented extended. When retracted, they have the form of ovoid bodies of small size. The larva remains in the actinula condition only a few days.

PLATE II.

Development of the Hydroida, *continued. Figures from* Louis Agassiz.

C. can. crc. Circular canal.
cav. Cavity.
E. c b. Epiblast.
eb. gm. Epiblastic bud.
ex. man. External wall of the manubrium.
ex. ta. External wall of the tentacle.
ex. vel. External wall of the velum.
F. fd. Constriction in umbrella.
G. ga. Stomach.
gm. Bud.
H. h b. Hypoblast.
hb. gm. Hypoblastic bud.
I. i. man. Internal wall of the manubrium.
i. ta. Internal wall of the tentacle.
i. vel. Internal wall of the velum.
i. w. Internal bell wall.
M. man. Manubrium.
man'. Confluence of the manubrium and bell.
mds. gm. Medusa bud.
2 *mds. gm.* } Successively formed medusa buds.
3 *mds. gm.* }
m. w. Middle wall.
N. ncl. Nucleolus.
nl. Nucleus.
O. ocl. Ocellus.
O. or. Mouth.
P. pig. Pigment.
py. Polyp.
py. ta. Tentacle of the hydroid.
py. ta'. Inside (around the mouth) row of hydroid tentacles.
R. r. tb. Radial tubes.
T. ta. Tentacles.
ta'. Tentacular bulb cavity.
tab. Enlargement of the tentacle at the union with the border of the bell.
tb. – *tb⁶.* Chymiferous tubes.
tb. ta. Tube which lies in the same portion of bell (spheromere) as that from which the tentacle hangs.
U. ubr. Umbrella.
V. vel. Velum.
vt. Vitellus.
vt. m. Vitelline membrane.
X. x¹, x². Inverted external wall.
ζ. Projection of the umbrella near the margin.
θ. Chitinous perisare.
θ'. Ferule-like enlargement of the perisare.
λ. λλ. Hydroid head.

The figures on this plate were arranged by A. Agassiz.

1–23, from Agassiz, Contributions to the Natural History of the United States, Vol. III. Pls. XVII. figs. 2, 11, 12; XVIII. 1, 2, 3, 4, 5, 6, 10, 11, 12, 14, 15ª. Vol. IV. Pl. XXV. figs. 2, 2ª, 3, 4, 5, 9, 12, 13, 14, 15.

1–16. *Coryne mirabilis*, Ag.

1. Ovum. *ncl.* Nucleolus. *nl.* Nucleus. *vt.* Vitellus. *vt. m.* Vitelline membrane.
2. A medusa bud just beginning to form. *c b.* and *h b.* Outer and inner layer of the hydroid. *cb. gm.* and *hb. gm.* Outer and inner layer of the bud.
3. Bud little older than the last; "stretched longitudinally." *c b.* and *h b.* Outer and inner layers of the hydroid. *cb. gm.* and *hb. gm.* Outer and inner layers of the bud. *tb.* Beginning of the system of chymiferous tubes.
4, 5. Buds more advanced in age, in the latter of which radial tubes have developed, two of which are shown in profile. *c b.* and *h b.* Outer and inner layers of the hydroid. *tb.* Chymiferous tube.
6. Older bud showing chymiferous tubes from the side and face. *c b.* Epiblast of hydroid. *h b.* Hypoblast of the hydroid. *hb. gm.* Hypoblast of the bud. It will be noticed that the latter would seem to be the epiblast. I think it is either hypoblastic or a third layer, — the gelatinous layer (mesoblast ?). *tb.* Chymiferous tube in profile. *tb'.* Chymiferous tube in face.

7. Older embryo, in which a "horn-like sheath" (θ) (perisarc) has formed over the surface of the bud. *c b.* Epiblast of hydroid. *h b.* Hypoblast of the hydroid. *hb. gm.* Hypoblast of bud (?). This may be epiblastic. *tb.* Tube in profile. *tb'.* Tube in face.
8. Older bud, in which hypoblast and epiblast are well marked. *c b.* Epiblast. *h b.* Hypoblast. The circular canal (*can. crc.*) is beginning to form by an approximation of two radial chymiferous vessels on each side. x^1, x^2. Infolded outer wall. θ. Perisarc.
9. In this bud, somewhat older than the preceding, the circular canal (*can. crc.*) has formed by a coalescence of the extremities of the radial tubes. *c b.* Epiblast. *h b.* Hypoblast. *i. w.* Internal bell wall. *m. w.* Middle bell wall. *man.* Manubrium. *ta.* Tentacle.
10. Older bud, in which the circular canal (*can. crc.*) is fully formed, and a velum is developed. *c b.* Epiblast. *ex. ta.* External wall of the tentacle. *ex. man.* External wall of the manubrium. *ex. vel.* External wall of the velum. *i. man.* Internal wall of the manubrium (?). *i. ta.* Internal wall of the tentacle. *i. vel.* Internal wall of the velum. θ. Perisarc.
11. Older medusa bud, with tentacles coiled up in the future bell cavity. *can. crc.* Circular canal. *c b.* Epiblast. *ex. man.* External wall of the manubrium. *ex. ta.* External wall of the tentacle. *ex. vel.* External wall of the velum. *i. man.* Internal wall of the manubrium. *i. ta.* Internal wall of the tentacle. θ. Perisarc.
12. A constriction takes place at the point where the medusa bud rises from the hydroid, and the bud is separated from its attachment and swims away. The perisarc is ruptured to allow this escape. Free medusa, called *Sarsia*, which, according to Agassiz, develops from the buds of *Coryne* (tentacles cut off). *fd.* Folds in the side walls of the bell. *man.* Manubrium. *or.* Mouth. *tb.* Chymiferous tube. σ. Remnant of a tube which formerly connected the cavity of the hydroid and that of the manubrium.
13. Older *Sarsia*. *man.* Manubrium; the upper letters (*man.*) indicate a bulbous enlargement of the cavity of the manubrium where it joins the hydroid. *can. crc.* Circular canal. *or.* Mouth. *ta.* Tentacles. *ubr.* Umbrella. *vel.* Velum.
14. *Coryne*, showing the relationship of the medusa-buds (future *Sarsia*) to the tentacles of the hydroid. *mds. gm.* Medusa buds. *py.* Hydro-polyp axis. *py. ta.* Polyp tentacles.
15. The male hydroid; the almost perfect medusa is persistent, "developing the spermatic mass around the proboscis to an enormous extent," Agassiz. *or.* Mouth. *py. ta.* Tentacles of the hydroid. *py. s.* Stem of the polyp. *man.* Manubrium, "loaded with sperm." *ta.* Tentacle. σ. Point of attachment of bud (gonophore ♂) to the hydroid.
16. A more developed male gonophore, which, according to Agassiz, is persistent, and has discharged the spermatic contents. *vel.* Infolded velum. σ. Point of attachment of the umbrella to the hydroid.

17–23. *Hybocodon prolifer*, Ag.

17. A profile view of the head of the hydroid, crowded with medusa buds (*mds. gm*). *py. ta.* Peripheral row of tentacles. *py. ta'.* Middle row of tentacles. *py.* Hydroid axis. θ. Ferule-like enlargement of the perisarc. λ. λλ. Bases of tentacles (peripheral).
18. Head of a hydroid, with the circle of peripheral tentacles (*ta.*) cut off. *mds. gm.* Medusa buds. *py.* Hydroid axis. θ'. Ferule-like enlargement of the perisarc.
18ª. Head of the hydroid without medusa buds, showing the position of the two rows of tentacles. *py. ta.* and *py. ta'.* Tentacles drawn together.
19. A young bud in earliest condition.
19ª. The same; somewhat older. *c b.* Epiblast. *h b.* Hypoblast. *tb.* Chymiferous tubes.
20. A well developed medusa, just before rupturing its connection with the hydroid, and showing the tentacles on one side. *cav.* Bell cavity. *can. crc.* Circular canal. *c b.* Epiblast. *h b.* Hypoblast. *man.* Manubrium. *man'.* Base of manubrium, the cavity of which is somewhat enlarged. *mds. gm.* Medusa buds. The second and third formed buds have begun to appear, and are lettered in order of appearance, — 2 *mds. gm.*, and 3 *mds. gm.* *ta.* Tentacle. *ta'.* Base of tentacle not yet enlarged into a bulb. *tb. ta.* Chymiferous tube in the same spheromere as that to which the tentacle hangs. tb^3. Tube diametrically opposite the tentacular tube. tb^6. Chymiferous tube facing the observer. tb^4. Continuation of a chymiferous tube into one of the tentacles. ξ. Enlargement of the tube at the junction of tb^4 and the circular canal (*can. crc.*).
20ª. A (female ?) medusa partially developed from the base of the tentacle. *cav.* Internal cavity. *c b.* Epiblast. *hb.* Hypoblast. *tb., tb'.* Chymiferous tubes in profile and in face. 2 *mds. gm.* A secondary medusa, budding from the walls of the first. The medusa buds represented in the figure are taken from a medusa already formed.
21. View of a medusa older than the last, still attached to the hydroid (seen looking at the inner face of the tentacle). *cav.* Bell cavity. *c b.* Epiblast. *gm.* A small bud, which will probably later develop into a tentacle. *hb.* Hypoblast. *man.* Manubrium. *man'.* Base of manubrium. *mds. gm.*–3 *mds. gm.* Medusa

buds in various conditions of growth. *ta.–ta*^{3}. Tentacles. *tb. ta.* Chymiferous tube, which lies in the same spheromere as the cluster of tentacles.

22. Medusa just escaped from its hydroid connection with a single well developed tentacle. *can. circ.* Circular canal. *man.* Manubrium. *r. tb.* Radial tube. *ta.* Tentacle. *ta′.* Cluster of small bodies at the tentacular base. *tb. ta.* Tentacular tube. *vel.* Velum. ζ. A symmetrical development of the umbrella near the origin of the tentacle.

23. The same, a day after freedom from hydroid (seen from oval side). *can. circ.* Circular canal. *man.* Manubrium. *pig.* Pigment ? *ta.* Tentacle. *ta′.* Cluster of bodies at the base of the tentacle. *tb. ta.* Tentacular tube. *vel.* Velum.

PLATE III.

Development of the Hydroida, *continued. Figures from* Louis Agassiz, George J. Allman, G. von Koch, *and* A. Kowalewsky.

A.	*apex.*	Apex. Opercular summit of gonangium.	
B.	*bl sto.*	Blastostyle.	
C.	*can. crc.*	Circular Canal.	
	cal.	Calyx, calycle, hydrotheca.	
	cav.	Cavity.	
E.	*e b.*	Epiblast.	
	e b'.	Epiblast of stem.	
G.	*ga.*	Stomach.	
	ga. cav.	Gastric cavity.	
H.	*h b.*	Hypoblast.	
	h b'.	Hypoblast of stem.	
M.	*man.*	Manubrium.	
	mem.	Membrane.	
O.	*o cy.*	Otocyst.	
	or.	Mouth.	
	om.	Ovum.	
P.	*pr.*	Club-shaped body.	
R.	*r. tb.*	Radial tubes.	
T.	*ta.*	Tentacles of free or unattached form, gonophore.	
	ta'.	Tentacles of hydranth.	
	tb.	Radial tubes.	
U.	*ubr.*	Umbrella.	
	γ.	Perisarc.	
	θ.	Perisarc of calycle.	
	σ.	Ferule-like enlargement of the peduncle of the calycle.	
	ϕ.	Spadix of the sporosac.	

Figures 1–5, 6–12ᵃ, 15, 16, were arranged by A. Agassiz.

1–5. *Obelia commisuralis*, McCr. From Agassiz, *op. cit.* Vol. IV., Pl. XXXIV. figs. 13, 13ᵃ, 16, 17, 18.

1–5ᵃ. Development of the medusa.

1. Profile view of a medusa bud just forming on the hydroid. *tb.* Chymiferous tube. *ubr.* Umbrella.
2. End view of a bud of the same age. *tb.* Chymiferous tube.
3. Two medusa-buds in different stages of growth. *e b.* Epiblast. *h b.* Hypoblast. *man.* Manubrium. *t b.* Chymiferous tube. *ubr.* Umbrella.
4. A medusa-bud, in the calycle, from the blastostyle. *c b.* Epiblast. *hb.* Hypoblast. *t b.* Chymiferous tube. *ubr.* Umbrella.
5. Free medusa (gonophore) as it escapes from the calycle (view from below). *can. crc.* Circular canal. *man.* Manubrium. *o cy.* Otocyst. *or.* Mouth. *ta.* Tentacle.

5ᵃ. *Obelia geniculata*, Allm. from Allman, A Monograph of Gymnoblastic or Tubularian Hydroids. *Ray Soc.*, 1869, p. 35, fig. 10.
Sexual zooid with ova (*om.*) budding from the radial canal (*r. t b.*) *ubr.* Umbrella. ϕ. "Spadix of the sporosac."

6–11. Development of the hydroid head (hydrauth).

6–11. Clytia poterium, Ag. From Agassiz, *op. cit.* Vol. IV., Pl. XXVIII. figs. 4, 6, 7, 8, 9.
These figures show the successive stages in the growth of the hydranth up to the stage (fig. 11) in which it approximates the form of the adult. *cav.* Cavity of the calycle surrounding the axis. *cal.* Calycle (horny cup). *c b.* Epiblast. *c b'.* Epiblast of the pedicle. *ga.* Stomach. *h b.* Hypoblast. *h b'.* Hypoblast of the pedicle. θ. Perisarc.

12ᵃ–12ᵉ. Development of *Laomedea flexuosa*. From Allman, *op. cit.* p. 72.
12ᵃ–12ᵉ. Development of the hydranth.

12ᵃ. "Very early condition, in which the bud forms a simple cylindrical cæcal offset from the coenosome."
12ᵇ. "The distal extremity of the bud has become enlarged, so as to present the form of an inverted cone."

12ᵉ. "The cone has increased in size, and the soft parts towards its proximal end have become retracted from the external chitinous walls."

12ᵈ. "The internal structures have still further withdrawn themselves from the chitinous walls, with which they are now in contact only by a narrow proximal and a wider distal zone, between which they present the form of a tubular cylindrical column."

12ᵉ. "The distal zone of contact has become retracted from the summit of the cup-like envelope of chitine, tentacles have begun to sprout from its circumference, and a hypostome has risen from its centre. The leading features of the completely-formed hydranth are thus established, and its chitinous envelope has become the hydrotheca."

"The arrows in the figure indicate the direction of the currents in the somatic fluid." Allman, p. 72.

13ᵃ–13ᶠ, 14ᵉ–14ᵏ. *Laomedea flexuosa*. From Allman, *op. cit.* p. 86.
13ᵃ–13ᵇ. Development of the morula from the ovum.

13ᵃ. "Young ovum in the gonophore previously to the disappearance of the germinal vesicle ; the germinal vesicle is here seen to contain several germinal spots."

13ᵇ. "The germinal vesicle and spots have disappeared."

13ᶜ. "The vitellus has become cleft into two segment spheres."

13ᵈ. "The ovum after a second cleavage."

13ᵉ. "The segmentation-spheres have become numerous, and many of them now show a distinct nucleus."

13ᶠ. "The segmentation-spheres have greatly increased in number, and a nucleus can now be detected in each of them."

14ᵉ–14ᵏ. Development of a planula from the morula.

14ᵉ. "The segmentation-spheres have still further increased in number, while the most superficial have become arranged into a stratum distinguishable from the deeper portion of the ovum."

14ʰ. "The superficial stratum has become more distinct, and is now seen to be composed of long prismatic cells."

14ⁱ. "The ovum has begun to elongate itself, and one end has become folded on the remainder."

14ᵏ. "The embryo, just after its escape in the form of a ciliated planula."

(Quotations from Allman, in 12–14.)

15. *Laomedea flexuosa*. 16. *Obelia geniculata*. From Allman, *op. cit.* p. 48.

15. Gonangium, with ova in its cavity in different conditions of development. *apex*. Opercular summit. *bl sto*. Blastostyle. *mem*. Membrane investing the contents of the gonangium. The ova appear in different stages of growth inside this membrane.

16. Gonangium, with medusæ in different conditions of growth, budding from the blastostyle. *apex*. Opercular summit. *bl sto*. Blastostyle. *mem*. Membrane investing the budding medusæ. γ. Calycle. The buds escape through an apical orifice.

17, 18. *Laomedea amphora*, Ag. From Agassiz, *op. cit.* Vol. IV., Pl. XXX. figs. 3, 5.

17. Portion of a stem with attached hydranths and calycles.

18. Magnified view of a single hydranth. *cal*. Hydrotheca. *g a*. Stomach. *p r*. Proboscidiform elevation. *t a'*. Tentacles. σ. Ferule-like formation of the perisare.

19–25. *Eucope polystyla*. From Kowalewsky, НАБЛЮДЕНІЯ НАДЪ РАЗВИТІЕМЪ COELENTERATA., Pl. I. figs. 1, 3, 5, 8, 9, 10.

19. Segmented ovum.

20. Blastosphere, with the hypoblastic cells (*h b.*) budding into a central cavity. *e b*. Epiblast.

21. An older stage, more elongated and with thicker epiblastic cells. *h b*. Hypoblastic cells.

22. Planula with solid central mass of hypoblastic cells (*h b.*), surrounded by epiblast (*e b.*).

23, 24. Planula with a segmentation (gastric) cavity (*ga. cav.*). According to Kowalewsky the epiblast in an embryo of this age divides into two layers. The deeper of these layers is in our figure lettered hypoblast (*h b.*), as it is considered hypoblastic in origin. *e b*. Epiblast. *h b*. Hypoblast.

25. Section of embryo showing the four infolding walls. (Compare with the four infolding walls dividing the young attached Scyphostoma of *Chrysaora*, and the young Actinozoan.)

26–30. *Tubularia larynx*. From Koch, Vorläufige Mittheilungen über Cölenteraten. *Jenaisch. Zeitsch.* Vol. VII., Pl. XXVI. figs. 12, 15, 16, 17, 19. "More or less schematic.")

26. A Tubularian bud showing (*e b.*) Epiblast, and *h b*. Hypoblast. Between these an intermediate layer ?

27. Section of an embryo (actinula ?), showing beginnings of tentacles on each side.

28. Actinula. *cav*. Cavity. *e b*. Epiblast. *h b*. Hypoblast. *t a*. Tentacle. The axis of the tentacle is solid, and composed of hypoblastic cells.

30. An embryo which has just attached itself. (Section.)

PLATE IV.

Development of the Trachymedusæ. *Figures from* Hermann Fol, John McCrady, Elias Metschnikoff, Ernst Hæckel, *and* B. Uljanin.

B. *blp.* Blastopore.
E. *e b.* Epiblast.
e b'. Epiblastic cells.
e pl. Epiplasm.
G. *ga.* Stomach.
gm^1, *gm*^{2}. Buds in different conditions of growth.
H. *h b.* Hypoblast.
hb. c. Hypoblastic cells in centre of larva.
hb. ta. Hypoblast in the tentacular axes.
h pl. Hypoplasm.
L. *lab.* Lips.
M. *man.* Manubrium.
N. *n.* Nerve.
nl. Nucleus.
nt cy. Nematocyst.
O. *o cy.* Otocyst.
or. Mouth.
P. *pli.* Folds.
S. *se. cav.* Segmentation cavity.
S. *sp.* Spermatozoan.
T. *ta.* Tentacle.
ta^1. Points of attachment (tentacles ?).
ta^2. Tentacular prominence.
tb. Chymiferous tube.
U. *ubr.* Umbrella.
V. *vc.* Vacuoles.
vel. Velum.
vt. Vitellus.
vt. m. Vitelline membrane.
β. Star-shaped figure with dotted rays.
θ. Bridge connecting inner and outer cells.
σ'. Epiblastic cells.
ϕ. Rib connecting tentacular appendages with the bell margin.
ξ. Conical tongue projecting from the extremity of the tentacle with base surrounded by a cluster of nematocysts.

Figures 11, 12, 13, 19–27, 29, 30, were arranged by the author; the remainder were arranged by A. Agassiz.

1–10. *Polyxenia leucostyla.* From Metschnikoff, Studien über die Entwickelung der Medusen und Siphonophoren, *Zeit. f. Wiss. Zoöl.*, Vol. XXIV. Pl. III. figs. 1, 2, 3, 4, 5, 7, 8, 9, 10.

1. Free ovum just dropped in the water.
2. Ovum with four segments.
3. Segmented egg with eight segments.
4. Segmented ovum more advanced.
5. Morula.
6. A ciliated larva with an external (epiblastic) layer, and a spongy mass of vitelline cells.
7. An older larva, the body of which has become very much elongated, and the extremities are about to become tentacles. *hb. c.* Hypoblast of the central region of the body. *hb. ta.* Hypoblast of the tentacles. The difference between the cells in the two regions is evident.
8. Larva still older, in which two tentacles are formed.
9. Larva three days old, still ciliated, showing two long tentacles and the beginning of a new pair (*ta*^{2}). A gastro-cavity is seen in the middle of the larva below the new tentacle.
10. Larva four days old, with four tentacles, a well-marked stomach, and mouth. In older larvæ of *Polyxenia* four otocysts, each alternating with the tentacles, are next formed ; and later, an increase of the number of tentacles, until the adult form is reached.

11–13. *Cunina rhododactyla*. From Metschnikoff, *op. cit.*, Pl. V. figs. 1, 2, 7.

11. Youngest observed "cunina bud," found in the gastric cavity. Perhaps developed from an egg. The long projection upward, with solid hypoblastic axis, is a tentacle. There are two layers, and a gastric cavity in the body.
12. The same, still older, with two tentacles and a mouth opening already formed. In stages intermediate between this and figure 13 there is little change besides the addition of new tentacles and the growth of a "stolon" from the middle of the disk. From this stolon, when there are twelve tentacles, buds develop.
13. A larva with two buds (gm^1. and gm^2.) on the stolon. The oldest bud (gm^1.) has two tentacles and an open mouth. The second bud has no tentacles. While the fate of these buds is unknown, the original medusa, upon which the budding has ceased, was observed to develop into a medusa resembling the parent.

14–17. *Cunina octonaria*, McCr. From McCrady, Description of Oceania (Turritopsis) nutricula, *nov. spec.*, and the Embryological History of a singular Medusan Larva, found in the cavity of its Bell, Pl. VI. figs. 20, 27 ; Pl. VII. figs. 32, 33.

14. Larval *Cunina*, found hanging in the bell cavity of *Modeeria* (*Turritopsis*) *nutricula*, McCrady. *ga.* Stomach opening through a long, flexible, tube-like body, through a terminal mouth (*or*). *ta.* Tentacles by which the larva hangs.
15. A still older larva, in which the umbrella (*ubr.*) and the otocysts (*o cy.*) have begun to form. Four tentacles have developed from the body in place of the two already formed. *ga.* Stomach. *or.* Mouth.
16. The young medusa now leaves the bell cavity of its host, and escapes in the form here represented. Seen from below (oral). *ga. c.* Gastric chamber. *man.* Manubrium. *o cy.* Otocyst. *ta.* Tentacle. *ubr.* Umbrella. This stage may be called the Ephyra stage.
17. Side view of the last. *o cy.* Otocyst. *ta.* Tentacle. *ubr.* Umbrella.

18–20. Development of *Cunina rhododactyla*.

18. A stolon taken from its attachment to the tongue of *Carmarina hastata*, with medusa buds in all conditions of growth.
19. From Uljanin, О ПРОИСХОЖДЕНІИ КУНИНЪ ПОЧКУЮЩИХСЯ ВЪ ЖЕЛУДКѢ ГЕРІОНИДЪ. ИЗВѢСТІЯ ИМПЕРАТОРСКАГО ОВЩЕСТВА ЛЮБИТЕЛЕЙ ЕСТЕСТВОЗНАНІЯ, АНТРОПОЛОГІИ И ЭТНОГРАФІИ. МОСКВА. 1876. Pl. I. fig. 9. A similar but smaller stolon, with many attached medusæ before liberation from attachment. ta^1. Points of attachment to the "tongue" of the *Carmarina*.
20. From Hæckel, *op. cit.*, Pl. VI. fig. 76. A bud which has loosened its attachment to the stolon and become free (Ephyra stage). *ga.* Stomach. *n.* Nerve. *o cy.* Otocyst. *or.* Mouth. *ta.* Tentacle. *tb.* Tube (?). *ubr.* Umbrella. *vel.* Velum.

21–36. Development of *Geryonia*. From Fol, Die erste Entwickelung der Geryoniden eies, *Jenaisch. Zeitsch.*, Vol. VII. Pl. XXIV. figs. 1, 2, 3, 5, 6, 7, 11, 12, 13, 15 ; Pl. XXV. figs. 16, 17, 18, 19, 23, 24.

21. Fertilized ovum with spermatozoa (*sp.*) in the mucus envelope. *pli.* Folds in the egg membrane. *n.* Nucleus. *e pl.* Epiplasm (upper plasmic layer). *h pl.* Hypoplasm (lower plasmic layer). *vt. m.* Vitelline membrane. λ. Mucus covering.
22. The first plane of segmentation, dividing the ovum into two segmentation spheres. *e pl.* Epiplasm. *h pl.* Hypoplasm. *nl.* Cell nucleus. β. Protoplasmic dots arranged in star rays.
23. Embryo after the formation of a second plane of segmentation. *e pl.* Epiplasm. *h pl.* Hypoplasm. *nl.* Nucleus. *pli.* Folds in the membrane of the egg. *vc.* Vacuoles between the spheres. *vt. m.* Vitelline membrane.
24. Embryo after the formation of the fourth plane of segmentation, consisting of sixteen cells. A segmentation cavity is found within, into which opens a blastopore (*blp*). *nl.* Cell nucleus. *vc.* Row of vacuoles.
25. The ovum after the formation of the fifth plane of segmentation, consisting of thirty-two cells. The process of cell division, known as delamination, has begun in this embryo. *blp.* Blastopore. *vc.* Row of vacuoles. Each of the thirty-two segments is divided into two unequal parts, of which the smaller is formed of granular, and the larger of granular and transparent protoplasm. In the next stage a division of the thirty-two larger cells takes place, and in each of these a line separates the granular from the transparent protoplasm. The sixty-four masses of lens-like shape, composed of granular protoplasm, thus formed, go to make up an outer epiblastic layer, while the thirty-two masses of transparent protoplasm form the hypoblast.
26. The ovum after the sixth plane of segmentation. It consists of thirty-two small cells, external (*e pl*), and thirty-two large cells (*h p'*). *sc. cav.* Segmentation cavity. Already the division of the cells (*e pl*) into σ, σ', has begun.

27. Embryo with sixty-four lenticular cells, forming the epiblastic vesicle, and thirty-two masses, composed of transparent protoplasm, the hypoblast (*h b*).
28. Cell at the beginning of the sixth plane of segmentation. *c pl.* Epiplasm. *h pl.* Hypoplasm.
29. The epiblastic layer now grows faster than the hypoblast, and the space between them increases, while at points they grow together. Appearance of the ovum towards the close of the formation of the seventh plane of segmentation. *c pl.* Epiplasm. *h pl.* Hypoplasm. *β.* Bridge connecting the two.
30. Appearance of an ovum a day after fructification. *c pl.* Epiplasm. *c b.* Epiblast. *h b.* Hypoblast. *h pl.* Hypoplasm. *nl.* Cell nucleus. *vt.* Vitellus.
31. The wide cavity between the two layers, epiblast and hypoblast, now becomes filled with a gelatinous layer. The embryo becomes ciliated, and at the point where epiblast and hypoblast fuses, the epiblast (*c b.*) is thickened and forms a disk, through which opens a mouth. Embryo thirty hours after impregnation. *c b.* Epiblast. *c b'.* Disk-like epiblastic thickening. The disk is seen between the dots (*c b'*). *h b.* Hypoblast. *ubr.* Umbrella, gelatinous tissue of a middle layer.
32. Embryo forty hours after impregnation. *c b'.* Edge of the epiblastic disk. *h b.* Hypoblast, which fuses with the epiblast at this point. *ubr.* Umbrella. The epiblast (*c b.*) is spread as a thin invisible layer over the surface of the umbrella.
33. The oral pole of the embryo three days and ten hours after fecundation. *c b.* Epiblast. *or.* Thickened epiblast, which later breaks through and forms a mouth. *h b.* Hypoblast.
34. Oral pole of an embryo six days and twelve hours old (after fecundation), with mouth widely open, and the border of the umbrella (*ubr.*) drawn somewhat together. *c b.* Epiblast. *h b.* Hypoblast. *ϕ.* Solid axis of tentacle. *ξ.* Conical projection at the extremity of the tentacle.
35. Older larva with lips and umbrella shown from below. The tentacles are widely extended. *cb.* Epiblast. *ga.* Stomach. *lab.* Lips of entrance to stomach cavity. *nt cy.* Nematocyst. *vel.* Velum. *ϕ.* Connection of the bases of the tentacle with the bell margin.
36. Oldest larva, which swims for the most part by means of movements of the velum (*vel*). No cilia. *ga.* Stomach. *lab.* Lip. *nt cy.* Nematocyst. *ta.* Tentacle. The small buds on the rim of the bell indicate the future sense bodies as well as rudimentary tentacles. *ubr.* Umbrella. *ϕ.* Tentacular axis of solid hypoblastic cells, and the same axis continued from the base of the tentacle to the bell margin.

PLATE V.

Development of the Trachymedusæ, *continued. Young Stages of the Medusæ of the* Hydroida, *and* Acraspeda. *Figures from* Alexander Agassiz, George J. Allman, J. Walter Fewkes, Ernst Haeckel, *and* Fritz Müller.

C. can. crc. Circular canal.
cav. Cavity.
E. em. ta. Embryonic tentacle.
G. ga. Stomach.
gm. Bud.
H. hy th. Hydrotheca.
L. lab. Lip.
l. rm. Lateral ramus, corbula rib.
M. man. Manubrium.
mds. gm. Medusa bud.
N. nt cy. Nematocyst.
O. oa. vs. Ovarian vesicle.
ocl. Ocellus.
ocy. Otocyst.
or. Mouth.
P. pap. Papilla.
R. r. tb. Radial tube.
r. tb'. Radial tube which has not yet grown to the circular canal.
T. ta. Tentacle.
tb., *tb'.* Chymiferous tubes.
U. ubr. Umbrella.
V. vel. Velum.
α. Unruptured perisare at the extremity of a branch.
β. Chitinous envelope ruptured, and the cœnosarc protruding.
ζ. The cœnosarc protruding more than in β.
γ. Body escaped from the hydroid.
η. New branch.
θ. Tube formed about the bud.
π. Base of attachment.

1–2. *Glossocodon eurybia* (*Liriope eurybia*). From Haeckel, Beiträge zur Naturgeschichte der Hydromedusen, Erstes Heft. Die Familie der Rüsselquallen (Geryonida), Pl. III., figs. 29, 30.

1. Young larva, with bell fully formed, seen from the oval side. The beginnings of four tentacles, which later form the embryonic tentacles, are seen as four small buds. *vel.* Velum.
2. Larva of about the same age, seen from one side. *ubr.* Umbrella.

3. From Fritz Müller, *Archiv für Naturgeschichte.* 1859. Pl. XI., fig. 16.

3. Still older medusa, seen from one side. The provisional tentacles are considerably developed, and from their tips project the tongue-like spurs. *cav.* Cavity of the bell. *ubr.* Umbrella.

4–7. *Glossocodon tenuirostris*, sp. Ag. From Fewkes, Notes on Acalephs from the Tortugas, with a Description of New Genera and Species. *Bull. Mus. Comp. Zoöl.* Vol. IX., No. 7, Pl. VII., figs. 2–5.

4. Larval medusa with stiff embryonic (transitory) tentacles (*em. ta.*), in which the permanent tentacles are not developed. *man.* Manubrium (rudimentary in character). *r. tb.* Radial chymiferous tube. The club-shaped bodies are, comparatively speaking, very large.
5. Older larva, in which the embryonic tentacles (*em. ta.*) have somewhat diminished in size, and a true tentacle (*ta.*) has begun to form.
6. Older larva, where the tentacles (*ta.*) have grown much longer. The manubrium (*man.*) has also increased very greatly in size. Embryonic tentacle (*em. ta.*) reduced in size; almost lost.
7. Older larva, wholly destitute of embryonic tentacles, while the true permanent tentacles (*ta.*) are very long, as in adult. *man.* Manubrium. *r. tb.* Radial tube. *ubr.* Umbrella.

8–15. From Allman, *op. cit.*, Pl. VIII. figs. 3, 7 ; Pl. IX. figs. 3, 4 ; Pl. XI. fig. 9 ; Pl. XVIII. fig. 4 ; Pl. XX. fig. 4.

8, 9. *Dicoryne conferta*, Alder.

8. "The female locomotive, ciliated sporosac, shortly after its liberation," "as it appears when swimming." It is viewed at right angles to the plane of its two tentacles.

9. Longitudinal section (optical) of a female sporosac made at right angles to the plane of the tentacles, and viewed under slight pressure.

10. Actinula of *Tubularia indivisa.*, Linn. A zoöid homologous to a free medusa, which is formed in small spherical sacs, hanging from an axis, dependent between the tentacles of the hydroid.

"The actinula, shortly after liberation. It is figured in the attitude assumed when moving from place to place ; the mouth is turned to the surface over which the actinula is moving, while some of the long tentacles are bent in the same direction, and are employed as ambulatory organs." Allman.

11. *Clavatella prolifera*, Hincks. An ambulatory larva, seen from the side, using its outstretched tentacles as walking organs.

12. Young stage of a free medusa (gonophore) of *Perigonimus.*

13. Young medusa of *Bougainvillia*, represented as it appears in motion. The bell walls are contracted, and the velum is pushed outward.

14. An older (?) *Bougainvillia*, floating passively, with tentacles widely extended. Subsequent growth from a medusa in this condition into that of the adult takes place simply by an increase of the number of tentacles and eye-spots in the bundles at the bell-rim, and an additional complication of the lips.

15. The same, older.

16. Medusa of *Occania languida.* From a sketch by Fewkes.

The youngest stage of this gonophore. *man.* Manubrium. *ta.* Tentacle. *tb.* Chymiferous tube. *ubr.* Umbrella. *vel.* Velum.

17–18. *Zygodactyla Groenlandica*, A. Ag. From Fewkes, Studies of the Jelly-fishes of Narragansett Bay. *Bull. Mus. Comp. Zoöl.* Vol. VIII., No. 8, Pl. V. figs. 5, 6.

17. Youngest known medusa of this genus, seen from the oral side of the disk. *can. circ.* Circular canal. *man.* Manubrium. *o cy.* Otocyst. *r. tb.* Radial tube. *r. tb'.* Radial tube, which has not yet extended to the circular canal. *ta.* Tentacle.

18. Same larva seen in profile. *man.* Manubrium. *r. tb.* Radial tube. *r. tb'.* Intermediate radial tube, which has not yet extended to the circular canal. *o cy.* Otocyst. *ta.* Tentacle. The fully-grown medusa has a very large number of radial chymiferous tubes, otocyst and tentacles.

19. *Willia ornata.* From A. Agassiz, *op. cit.*, fig. 274[a]. Young gonophore in which the tubes have just begun to bifurcate (*r. tb.*). The youngest form has four undivided tubes, alternating with four simple bundles of nematocysts in the bell walls.

20–22. *Lizzia octopunctata.* From Fewkes, Studies of the Jelly-fishes of Narragansett Bay. *Bull. Mus. Comp. Zoöl.*, Vol. VIII., No. 8, Pl. I. figs. 1, 3, 6.

20. Mother medusa, with buds in various conditions of growth forming on the outer walls of the proboscis. *mds. gm.* Medusa buds. The larger (*mds. gm.*) approximates in shape that of a medusa. *lab.* Lip. *o cl.* Ocellus. *or.* Mouth. *ta.* Tentacle. *ubr.* Umbrella. *vel.* Velum.

21, 22. Developed buds, with the form which they have when just escaped from the parent manubrium.

21. Young medusa (oral view). *cav.* Bell cavity. *o cl.* Ocellus. *ta.* Tentacle. *ubr.* Umbrella. *vel.* Velum.

22. Side view of the last. *man.* Manubrium, at the base of which are buds of a third generation. *r. tb.* Radial tube. *ubr.* Umbrella. At the apex there is a canal which formerly afforded free communication between the cavity of the manubrium of the parent and that of the bud. The bud, when it severs its connection with the parent, has on the bell rim sixteen tentacles, consisting of four bundles of three tentacles each, and, alternating with these, four single tentacles.

23. Young of *Haliclystus* (*Lucernaria ?*) From A. Agassiz, North American Acalephæ. *Illustrated Catalogue Mus. Comp. Zoöl*, No. 2, p. 63. *or.* Mouth. *ubr.* Umbrella. π. Base of attachment.

23[a]. A group of tentacles of the same, in different stage of growth.

24[a]–24[d]. *Schizocladium ramosum.* From Allman, *op. cit.*, p. 152.

24[a]. "Part of an adult colony, magnified about six diameters." α. A terminal part of a branch still invested by a chitinous perisarc. β. The perisarc of this branch has been ruptured, while the contained cœnosarc has protruded a little, and is visible at the extremity. ζ. The separation of a small body of cœnosarc from

the branch has been completed, and the portion thus separated has almost freed itself from the branch. γ. A body of cœnosarc (frustule) has dissolved its connection with the hydroid, and become a free planula-like body swimming in the water.

24^b. Hydroid formed by a gemmation from the free frustule.

24^c. The frustule (γ), after swimming about in the water, secretes a mucus tube (θ), into which it is represented in the figure as partially drawn on the right hand side (of figure).

24^d. A bud has been sent out from the extremity of the frustule ($g\,m$). This bud increases in size, and ultimately forms the hydroid, with hydranth (24^b). From the side of this hydroid a branch (η) is emitted.

25^a–25^e. Development of a Corbula in the family of *Plumularidæ*. From Allman, *op. cit.*, p. 60.

25^a–25^e. *Aglaophenia pluma.*

25^a. A very young corbula. *l. rm.* Lateral branch.

25. Older stage of the corbula, with the ovarian vesicles (*oa. vs.*) already formed as spherical sacs, arising from the midrib of the corbula, between the lateral rami (*l. rm*).

25^c. The same, older. *oa. vs.* Ovarian vesicles, called gonangia. *l. rm.* Lateral rami (costæ.) *hyth.* Single hydrotheca.

25^d. Mature corbula. The serrated bodies along the sides are called nematophores. The corbula is a specialized basket-shaped structure found in certain sertularian hydroids, for the protection of the vesicles and their ova.

26. Young *Cyanea arctica*, showing the umbral papillae. From Fewkes, Studies of the Jelly-fishes of Narragansett Bay. *Bull. Mus. Comp. Zoöl.*, Vol. VIII., No. 8, Pl. VII. fig. 1.

PLATE VI.

Development of the Discoidea *and* Siphonophora. *Figures from* Alexander Agassiz, Carl Chun, J. Walter Fewkes, Ernst Hæckel, Elias Metschnikoff, *and* P. E. Müller.

A.	*a.*	Anterior.		*ms b.*	Mesoblast.
	a. nc x.	Anterior nectocalyx.	*N.*	*nc x.*	Nectocalyx.
	ax.	Axis.		*nt cy*	Nematocyst.
C. C. P. L.		Chamber or tube in the primitive hydrophyllium, which is derived from a cavity early formed in the ovum.	*O.*	*oa.*	Ovary.
				or.	Mouth.
			P.	*pnb.*	Undigested food in the stomach.
	cil.	Cilium.		*pig.*	Pigment.
	cl.	Cell.		*pn cy.*	Pneumatocyst.
E.	*e b.*	Epiblast.		*p nc x.*	Posterior nectocalyx.
	e b'.	Infolded portion of the epiblast.		*pyt.*	Polypite.
	em. ta.	Embryonic tentacle.	*R.*	*r. tb.*	Radial tube.
F.	*fil. hy cy.*	Filament of the hydrocyst.	*S.*	*so cy.*	Somatocyst.
G.	*ga.*	Stomach.	*T.*	*ta.*	Tentacle.
	gm.	Bud.	*U.*	*ubr.*	Umbrella.
	go ph.	Gonophore.	*V.*	*vel.*	Velum.
H.	*h b.*	Hypoblast.		*vt.*	Vitellus.
	h b'.	Large cells (vitelline cells), hypoblastic ?		α.	Float.
				β.	Partitions which separate the chambers found in the frame-work supporting the sail.
	hp.	Liver ? Cluster of "brown cells."			
	hy ph.	Hydrophyllium.		γ.	Partitions which separate the concentric chambers of the float in the disk.
	hy cy.	Hydrocyst.			
I.	*i.*	Interior of bell.		θ.	Rim of the disk.
L.	*la. ap.*	Peduncle of a tentacular appendage (tentacular knob).		λ.	Feelers on the under side of the disk.
				σ.	Sail.
M.	*mb.*	Membrane.			
	mds. gm.	Medusa bud.			

1. From a Sketch by A. Agassiz.

1. Sexual cluster of male and female gonophores of *Physalia*. *mds. gm.* Undeveloped medusa bud. *go ph.* Female gonophore ♀, male ♂.

2–4. From A. Agassiz, Exploration of the Surface Fauna of the Gulf Stream. *Mem. Mus. Comp. Zoöl.* Vol. VIII., No. 2, Pl. VI. figs. 1, 2, 3.

2. Young *Velella* in profile. *hp.* Liver ? θ. Rim of the disk. λ. Prehensile tentacle (hydrocyst ?). σ. Sail. A large feeding polyp (polypite) hangs down from the middle of the disk on the under side.
3. Young of the same, from below (oral view). In the centre is seen the mouth (*or*). θ. Border of the disk. λ. Prehensile "tentacles" ? These bodies (λ), like the hydrocysts of *Physophora*, are prehensile.
4. The same, a little older, in which the ramifications of the liver extend to the disk margin or horizontal mantle. *pyt.* Central feeding polyp or polypite. λ. Prehensile tentacles (hydrocysts).

5–7. *Rataria*. From Sketches by Fewkes.

5. Section through *Rataria* (young *Porpita* or *Velella ?*), found with *Velella spirans*. The section passes vertically through sail, disk border, and retracted polypite. The sail is seen to be composed of a superficial

wall or membrane (*mb.*) stretched over two vertical plates, which are parallel, and united by horizontal floors (*β.*). The lowest of the chambers between two floors (*α*) is a float. *γ.* Chambers (seven) situated between horizontal curved partitions in the body of the disk. *hp.* Liver? (brown cells). *θ.* Disk margin. *pyt.* Polypite.

6, 7. *Rataria*, from one side. *pyt.* Polypite. *θ.* Disk rim. λ. Prehensile tentacles (hydrocysts?). *σ.* Sail. Notice the characteristic vertical lines on external wall of the sail. The form of the sail, although unlike that of fig. 2, is not very distant from that of a *Velella* a little younger.

8, 9. From Agassiz, *op. cit.*, Pl. II. fig. 10; Pl. VIII. fig. 8.

8. Medusa of *Porpita*. *ubr.* Umbrella.

9. Medusa of *Velella*. *r. tb.* Radial tubes with yellow cells. *ubr.* Umbrella. *ta.* Tentacle. Rows of nematocysts are seen on the surface of the bell.

10–19. From Metschnikoff, Studien über die Entwickelung der Medusen und Siphonophoren. *Zeit. f. Wiss. Zoöl.* Bd. XXIV., Pl. VI. figs. 5, 7, 8, 9; Pl. VII. figs. 11, 14, 16; Pl. XI. figs. 6, 8; Pl. XII. fig. 9.

10–15. *Epibulia aurantiaca.*

10. Planula with interior filled with spongy cells, and an epiblastic cap (*e b.*) on the pointed pole. *a.* is arbitrarily taken as the anterior pole. *cl.* Spongy mass of cells.

11. Older embryo, in which a nectocalyx and tentacle have begun to form. The epiblast (*e b.*) rises in two prominences, the smaller of which is the bud of a tentacle (*ta.*), and the other a nectocalyx (*nc x.*) Under the epiblast is another layer, probably the hypoblast. The epiblast forms the lining of a cavity (the bell cavity). Cilia (*cil.*) still remain over the whole body. The whole vitellus (*vt.*) is taken up by the spongy mass of cells.

12. An older embryo than the last. Although this is a faithful copy of Metschnikoff's figure, it is, like his, believed to be faulty in this particular. The course of the epiblast, after it leaves the lower surface of the bell, on the side turned to the observer, probably passes by reflection into the walls of the tentacle, instead of to the upper pole of the embryo. The hypoblast closely covers the infolded part of the epiblast in the bell, and extends, also, into the tentacles. It also forms a loop (*so cy.*), the future somatocyst. A gelatinous layer also appears between hypoblast and external epiblast in the nectocalyx. Whole surface ciliated.

13. Older larva, with the primary nectocalyx of considerable size. *e b.* Epiblast which lines the bell cavity (*i.*) and is also stretched over the whole ovum. *h b.* A layer of hypoblast in the bell. At *so cy.* this hypoblast forms a loop, the future somatocyst. Between it (*h b.*) and the epiblast of the surface of the bell is a gelatinous layer (? it mesoblast.) *h b.* Swollen hypoblastic cells. *vt.* Vitellus with spongy cell mass. The large projection lined by cells (*h b'.*) becomes later a polypite. *Epibulia*, like *Crystallodes*, absorbs the vitellus, which is not directly changed into the polypite, as in some species of *Agalma.*

14. Older larva (primitive larva). *pyt.* Polypite with two layers best marked near the pointed end. *so cy.* Somatocyst. *ubr.* Umbrella. *vt.* Vitellus.

15. Oldest larva, in which the vitellus is wholly absorbed, and a small hydrophyllium (*hy ph.*) has formed in its place. A second nectocalyx (*a. nc x.*) has formed, which, from its future position, is called the anterior. It is regarded as homologous with *a. nc x.* of figures 30, 31. The distal end of the polypite (*pyt.*) is open, forming a mouth. *so cy.* Somatocyst. Although the intermediate larvæ between this and the adult *Epibulia* are not known, it is probable that the larger nectocalyx, with the somatocyst, is transitory, and is later lost. It can then be supposed that fig. 15 corresponds with a *Monophyes* larva, or a definite stage (fig. 29) in the cyclical development of *Muggiaea.*

16–17. *Gleba hippopus.* Forsk.

16. Embryo, with first nectocalyx beginning to form. Around the whole embryo is stretched an epiblast (*e b.*). The infolded portion of the epiblast (*e b'.*) forms the inner bell wall. The hypoblast (*h b.*) is found just below these two. Whole remainder of the vitellus taken up by a spongy mass of cells, which closely resemble the "fatty cells" of *Ctenophora* and other cœlenterate larvæ. The bell cavity probably forms by a dissolution of epiblastic cells (*e b'.*).

17. Larva, with a helmet-shaped bell (*ubr.*), fully formed. This stage may be called the primitive larva or *Monophyes* stage, and is homologous with figs. 14 and 29. The helmet-shaped bell is probably provisional. *e b.* Epiblast. *h b.* Hypoblast. *r. tb.* Radial tube. *vt.* Vitellus.

18. *Halistemma rubrum.* From Metschnikoff, *op. cit.*, Pl. X. fig. 6.

Larva with primitive nectocalyx (*nc x.*) beginning to form, showing also the young pneumatocyst (*pn cy.*). In larvæ younger than this we have two layers — epiblast and hypoblast — formed first; then an elevation of both, by which a cavity is left between the hypoblast and the vitellus. The first structure formed is a bell (*nc x.*); the second (*pn cy.*), a pneumatocyst; and the third (*gm.*), probably a tentacle. The pneumatocyst

is formed from a portion of the epiblast, which becomes surrounded by hypoblast. The cavity, as that of a nectocalyx, seems to form by an at first crescentic-formed dissolution of the epiblast. The vitellus (*vt.*) passes directly into the polypite. The bell (*nc x.*) is probably (?) provisional (primitive nectocalyx). The pigmentation (*pig.*) is characteristic.

19. *Agalmopsis* (*Stephanomia*, auct.) *pictum*, Fewk. From Metschnikoff, *op. cit.*, Pl. XII. fig. 9.
Embryo in which the pneumatocyst and embryonic tentacles are well developed. The development of this Physophore is exceptional in forming a float, instead of a nectocalyx, at the very beginning. The youngest larvæ becomes covered with a superficial layer — epiblast — which is ciliated, and concentrates at one pole, where it forms a pneumatocyst. The second structure to develop is the tentacle, and no sign of a nectocalyx has yet appeared. *pm cy.* Pneumatocyst, around which is what is left of the unabsorbed vitellus. The ovum has the spongy mass in its center. *pig.* Pigment on the pneumatocyst. *pyt.* Polypite, with a terminal mouth (*or.*). The distal end is pigmented. The prominent appendage to the polypite, the tentacle (*em. ta.*), as well as the knot-like bodies which hang from it, are provisional structures.

20–23. Development of *Physophora*. From Hæckel, Zur Entwickelungsgeschichte der Siphonophoren. Eine von der Utrechter Gesellschaft für Kunst und Wissenschaft Gekrönte Preisschrift, Pl. I. figs. 4, 8; Pl. II. fig. 20; Pl. III. fig. 24.

20. Embryo of *Physophora* at the close of the segmentation of the ovum. *e b.* Epiblast. *vt.* Spongy mass of vitelline cells.

21. Older larva, in which a primitive hydrophyllium has begun to form at one pole. *C. P. L.* Chamber in the first formed hydrophyllium. *e b.* Epiblast. *h b.* Hypoblast, which also encloses the chamber *C. P. L.* *ubr.* The layer between *e b.* and *h b.*, which forms the gelatinous body of the hydrophyllium. *vt.* Vitelline, or "spongy mass of cells."

22. An older larva (primitive larva), in which a primitive hydrophyllium is fully formed. *C. P. L.* Chamber of the primitive larva. *em. ta.* Embryonic tentacle. *gm.* Buds, the fate of which is not clearly known (probably hydrocysts). *h b.* Hypoblast. *ms b.* Gelatinous layer (mesoblast?). *pyt.* Polypite. *nt cy.* Nematocyst. *η.* Canal leading from the chamber, *C. P. L.*, to the cluster of nematocysts (*nt cy.*) (Radial tube of a nectocalyx?) The primitive hydrophyllium of this stage is a transitory structure.

23. Larva, after the loss of the primitive hydrophyllium. *fil. hy cy.* Filament of the hydrocyst. *hy cy.* Hydrocyst. *ga.* Stomach. *la. ap.* Lateral appendages to the embryonic tentacle. *ta.* Embryonic tentacle. *n cx.* First formed nectocalyx. *nt cy.* Nematocyst. *or.* Mouth, not yet open (?).

24. *Praya*. From Metschnikoff, *op. cit.*, Pl. VII. fig. 16.
Embryo in what may be called a *Monophyes* stage, which corresponds with the so-called primitive larva. *nc x.* Nectocalyx. *pyt.* Polypite. *so cy.* Somatocyst. *ubr.* Umbrella. The helmet-shaped body (primitive hydrophyllium), probably provisional.

25. *Diplophysa inermis*. From Fewkes, Studies of the Jellyfishes of Narragansett Bay, *Bull. Mus. Comp. Zoöl.*, Vol. VIII., No. 8; Pl. VI. fig. 12. *a. nc x.* Anterior nectocalyx. *go ph.* Gonophore ♀. *oa.* Ovary. *so cy.* Somatocyst. *ta.* Tentacle.

26, 27. *Diphyes Sieboldii*. From P. E. Müller, Iagttagelser over nogle Siphonophorer, *Naturh. Tidsskr.*, 3 R. 7 B., Pl. XI. fig. 1; Pl. XII. fig. 4.

26. Portion of a stem with two attached members, which later develop separately from each other and from the axis. *ax.* Axis. *hy ph.* Hydrophyllium. *pyt.* Polypite. A tentacle is also developed, and is shown retracted under the hydrophyllium.

27. "*Eudoxia* form" of one of the last after separation from the axis. *go ph.* Gonophore (♂?). *so cy.* Somatocyst. *ta.* Tentacle. *ubr.* Umbrella.

28. *Eudoxia Lessonii*. From Fewkes, *op. cit.*, Pl. VI. fig. 8. Fully developed *Eudoxia*. *go ph.* Gonophore ♀. *nc x.* nectocalyx. *oa.* Ovary. *so cy.* Somatocyst.
The tentacle is cut off below the third tentacular knob.

29–31. From Chun, Ueber die Cyclische Entwickelung und die Verwandtschaftsverhältnisse der Siphonophoren. *Sitzungs. Acad. Wiss. Berlin.* No. LII. p. 1155., Pl. XVII. figs. 1, 2, 4.
The successive stages in the cyclical growth of *Eudoxia*, according to Chun, are: I. *Monophyes* (29). II. *Muggiæa* (31). III. *Eudoxia* (28).

29. *Monophyes primordialis*. Chun, "First generation." A larva probably homologous with figs. 17, 24, and the young *Agalma* (Pl. VII. fig. 11), which has been called the primitive larva. *pyt.* Polypite. *r. tb.* Radial tube. *so cy.* Somatocyst. *ubr.* Umbrella.
The anterior nectocalyx (*Muggiæa* nectocalyx) may be developed from the small bud at the base of the polypite.

30. A larva which still retains a nectocalyx with the form of that of *Monophyes*, but has a second nectocalyx (*a. nc x.*) and a well-developed axis. The second nectocalyx (*p. nc x.*) is shaped like that of a *Muggiæa*. *a.* Anterior end of bell, as it moves in water. *p. nc x.* Posterior nectocalyx (nectocalyx of *Monophyes*). *pyt.* Polypite. *r. th.* Radial tube. *te.* Tentacle.

31. "*Muggiæa* larva." A larval (?) condition with a single characteristic nectocalyx, often, according to Chun, mistaken for a *Diphyes* with bell (posterior) broken off. *a. nc x.* Anterior nectocalyx. *ax.* Axis. *goph.* Gonophore. *hyph.* Hydrophyllium. *pyt.* Polypite. *soc y.* Somatocyst.

Each of these clusters on the stem probably develops into an *Eudoxia*-like medusa (28).

PLATE VII.

Development of the Siphonophora *continued. Figures from* Alexander Agassiz, J. Walter Fewkes, *and* Elias Metschnikoff.

A. *a.* Anterior.
ax. Axis.
C. *C. P. L.* Chamber in the larva, which ultimately becomes a canal in the primitive hydrophyllium.
cl. Cell.
cn. Canal.
E. *e b.* Epiblast.
e b'. Infolding or thickening of the epiblast to form the future pneumatophore.
em. ta. Embryonic tentacles, with embryonic knobs.
F. *fil. hy cy.* Filament of the hydrocyst.
G. *ga.* Stomach.
H. *h b.* Hypoblast.
hy cy. Hydrocyst.
I. *iv.* Involucrum.
L. *l. vs.* Lateral vesicle.
M. *ms b.* Middle layer (between epiblast and hypoblast), which forms the gelatinous body of the hydrophyllium (mesoblast ?).
N. *nc x.* Nectocalyx.
nc x'. Undeveloped nectocalyxes.
nl. Nucleus.
nt cy. Nematocyst.
O. *or.* Mouth.
P. *p.* Posterior.
pap. Papilla (?).
pig. Pigment.
P. *pn cy.* Pneumatocyst.
pn ph. Pneumatophore.
pr. hy ph. Primitive hydrophyllium.
py. Polyp.
py. s. Polyp-stem.
pyt. Polypite.
R. *r. tb.* Radial tube.
S. *sac.* Sacculus.
scr. hy ph. Serrated hydrophyllium.
T. *ta.* Tentacle.
t. vs. Terminal vesicle.
V. *v.* Ventral.
vt. Vitellus.
α. Ampulla-like enlargement of the canal of the first formed hydrophyllium.
β. Canal connecting this ampulla with that of the axis.
γ. Central tube in the serrated hydrophyllium.
ζ. Portion of a chamber in the primitive larva, which remains at the proximal end of the canal passing into the primitive hydrophyllium.
θ. Enlargement of the cavity in the tentacular knob.
λ. Point of internal attachment of the coiled part of the tentacular knob to the walls of the body which envelops it, and forms the outer walls of the knob.

1–25. Development of *Agalma*.

1–11. From the ovum to the "primitive larva." 12–20. From the primitive larva to the "*Athorybia* larva." 21, 22. From the "*Athorybia* larva" to the young resembling the adult.

1, 2. *Agalma Sarsii.* From Metschnikoff, *op. cit.*, Pl. VIII. figs. 1, 2.

1. Youngest larva, in which the epiblast (*e b.*) forms a polar cap. The vitellus (*vt.*) is penetrated by a protoplasmic network, which divides it into a spongy mass of glass-clear cells, as in *Ctenophora* and other *Siphonophora*. The external surface is ciliated.
2. An older larva, which has become elongated and more pyriform. The deeper layer (*h b.*), which is called endoderm (hypoblast) by Metschnikoff, may be the beginnings of the chamber *C. P. L.* The epiblast and hypoblast, probably both together, form the layer *e b.*

3-5. *Agalma elegans*, Fewkes. From sketches by Fewkes.

3. Larva older than the last, with the polar cap more raised and a central chamber (*C. P. L.*). The layer *e b.* was not observed to be differentiated into two or more divisions, although it may have component parts corresponding to the epiblast, hypoblast, or even an intermediate gelatinous layer (mesoblast). Nuclei (?) were observed in the vitelline cells.
4. Older larva, with the chamber (*C. P. L.*) surrounded by two layers. *e b.* Epiblast. *h b.* Hypoblast.
5. Side view of the last. The chamber (*C. P. L.*) of the primitive elevation, which is the primitive hydrophyllium, has become tube-like. *cl.* Vitelline cells (?). *nl.* Nucleus (?). *pig.* Pigment patches, with rough projections on the surface of the ovum.

6, 7. *Agalma Sarsii*. From Metschnikoff, *op. cit.*, Pl. VIII. figs. 6, 7.

6. Larva, showing the first formation of the pneumatocyst, which first appears as an epiblastic structure (*e b'.*). *e b.* Epiblast. *ms b.* Gelatinous thickening, forming the body of the primitive hydrophyllium, and destined later to increase to a very large size, when the epiblastic layer becomes a thin superficial layer of cells stretched over it. *ζ.* Recess above the spongy mass of vitelline cells.
7. Primitive larva. A common larval condition of the *Siphonophora*, which many genera of Physophoræ and Calycophoræ pass through, distinguished on account of a provisional hydrophyllium (or nectocalyx), covering as a helmet the vitellus, which may or may not pass directly into a polypite. The chamber *C. P. L.* is lined with hypoblast (*h b.*). The epiblast (*e b.*) is stretched over the vitellus, and extends as a very thin layer over the primitive hydrophyllium. The great size of the hydrophyllium is caused by the growth of the middle or gelatinous layer. *pn cy.* Pneumatocyst. *ζ.* Recess between the vitelline cells and the hydrophyllium.

8-10. *Agalma elegans*. From sketches by A. Agassiz.

8. Larva a little older than the last. *C. P. L.* Chamber of the hydrophyllium. *pr. hy ph.* Primitive hydrophyllium. *pn cy.* Pneumatocyst.
9. Still older larva. *C. P. L.* Chamber of the primitive hydrophyllium. *pr. hy ph.* Primitive hydrophyllium. *vt.* Vitellus. Of the three buds shown in the figure, the larger is the pneumatocyst, and the two smaller (lateral) the rudiments of the serrated hydrophyllia, which later assume great size. *vt.* Vitellus.
10. Older larva, with the primitive hydrophyllium (*pr. hy ph.*) bent over so as to hide the cavity (*C. P. L.*), and expose in profile the polypite and serrated hydrophyllium. By this movement the pneumatocyst (*pn cy.*) is brought to the middle of the figure, while at its left are several buds, which later develop into hydrophyllia.
11. *Agalma Sarsii*. From Metschnikoff, *op. cit.*, Pl. VIII. fig. 11.
Profile view of a larva, in which the margin of the provisional hydrophyllium has grown downward, covering the vitellus, from which, however, it is free at the edges. The epiblast (*e b.*) appears at a projection, generally more or less pigmented, which is beginning to push out at the side of the ovum. The hypoblast (*h b.*) is also visible at the same point, and also lines the chamber *C. P. L.* The vitelline cells are somewhat reduced in number. There are two regions of crimson pigment (*pig.*). The serrated hydrophyllia (*ser. hy ph.*) are conspicuous by reason, in part, of the large nematocysts in their walls.

12-17. *Agalma elegans*. From sketches by A. Agassiz.

12. Larva of about the same age, and represented in the same position as fig. 10, showing the serrated hydrophyllia (*ser. hy ph.*) in profile. *pn cy.* Pneumatocyst. *vt.* Vitellus.
13. Larva, showing the relation of the primitive hydrophyllium (*pr. hy ph.*) and the pneumatocyst (*pn cy.*) *vt.* Vitellus.
14. Primitive larva, seen in profile with the spongy mass of cells (*vt.*) hugging closely the inner wall of the epiblast. They here occupy a position similar to the same cells in *Epibulia* (Pl. VI. fig. 13 *h b*). *pn ph.* Pneumatophore. *pap.* Small tubercles, not figured in other figures, and doubtfully called papillæ. *ser. hyph.* Serrated hydrophyllia in profile. *C. P. L.* Chamber of the primitive hydrophyllium now reduced to a tube. *vt.* Vitellus.
15. Larva of the same age as the last, seen in a plane at right angles, laterally, and from below, indicating the position of the large cells in the vitellus (*v'.*). *or.* Mouth. *pn cy.* Pneumatocyst. *ser. hy ph.* Serrated hydrophyllia.
16. Older larva, in which the size of the serrated hydrophyllia (*ser. hy ph.*) has greatly increased, and a terminal cluster of nematocysts has appeared at the distal extremity of a tube situated medially in the hydrophyllium. *pn cy.* Pneumatocyst. *C. P. L.* End of the cavity of the hydrophyllium.
17. Larva older than the last, in which the primitive hydrophyllium has disappeared, and the polypite has become very much elongated. A single serrated hydrophyllium (*ser. hy ph.*) is sketched on one side to show its relations to the pneumatocyst (*pn cy.*). Of the small buds below it, the lowest — that with four black spots — is probably a tentacle, and the others are immature hydrophyllia.

18, 19. *Agalma Sarsii.* From Metschnikoff, *op. cit.*, Pl. IX. figs. 15, 17.

18. Larva, showing the connection of the embryonic appendages (primitive hydrophyllium and serrated hydrophyllia) with the polypite and pneumatocyst (*pn cy.*), by means of an axis (β). Four serrated hydrophyllia are shown. The connection of the cavity *C. P. L.* with that of the polypite is through an enlargement (ampulla α), into which the tubes of the several hydrophyllia appear also to open. The cluster of bodies at the base of the polypite, near its junction with the pneumatocyst, are embryonic tentacular knobs (figs. 23, 24). *ga.* Stomach cavity. *or.* Mouth.

19. Larva about the same age as the last, turned in such a way that a serrated hydrophyllium is shown in full face. The fore-shortened extremity of the tube (*C. P. L.*) of the primitive hydrophyllium is just visible. *pr. hy ph.* Primitive hydrophyllium. *pig.* Pigment at the base of the float (*pn ph.*). *ga.* Stomach. *nt cy.* Nematocyst. γ. Tube of the serrated hydrophyllium.

20. *Agalma elegans.* From Fewkes, Studies of the Jelly-fishes of Narragansett Bay. *Bull. Mus. Comp. Zoöl.*, Vol. VIII., No. 8, Pl. IX. fig. 2.

"*Athorybia* larva," embryo with a ring of provisional serrated hydrophyllia (*scr. hy ph.*), and embryonic tentacle (*em. te.*), with a provisional (?) axis. There is a remnant of a vitellus (*vt.*) which, in this species, does not pass into the polypite. Our species of *Agalma* seems to resemble *Crystallodes* in its method of absorption of the vitellus. The pneumatophore (*pn ph.*) is permanent. *pyt.* Polypite. γ. Median canal of the serrated hydrophyllium.

21. From Metschnikoff, *op. cit.*, Pl. XI. fig. 2.

An embryo older than the "*Athorybia* larva," with the serrated hydrophyllia characteristic of that stage, and with embryonic tentacle (*em. te.*). It has developed two nectocalyces at least (*nc x.*), a permanent axis (*ax.*), permanent tentacular knobs, two of which are to be seen in the lower centre of the figure just above the letters (*em. te.*). A radial tube (*r. th.*) is developed in the tentacle, and the pneumatophore (*pn ph.*) approximates in shape that of the adult.

22–29. From Fewkes, *op. cit.*, Pl. IX. figs. 1, 9, 9ª. Fig. 25, from sketch.

22. Larva still retaining, as an embryonic feature, the provisional tentacle and knob; but in other respects like the adult. Provisional hydrophyllia lost, and in their place permanent covering-scales (hydrophyllia). Axis divided into two parts; that which bears the nectocalyx (*nc.s.*), called the nectostem, and that which bears the remaining appendages, the polyp stem (*py. s.*). The permanent tentacle, with knobs characteristic of the genus *Agalma*, coexists with the larval tentacle (*em. te.*). Hydrocysts (*hy cy.*), with their filaments (*fil. hy cy.*) present. *nc x'.* Rudimentary nectocalyces. *pn ph.* Pneumatophore. *pyt.* A polypite.

23–24. Embryonic tentacular knob of *Agalma elegans.*

23. Side view.

24. Seen from below.

25. Outline of an undeveloped hydrophyllium, not serrated, found in a larval *Agalma elegans.* *a.* Anterior (place of attachment). *p.* Opposite end. *v.* Ventral (side turned to the axis).

26–29. Development of the tentacular knob of *Physophora hydrostatica.* From Fewkes, Contributions to a Knowledge of the Tubular Jelly-fishes. *Bull. Mus. Comp. Zoöl.*, Vol. VI. No. 7, Pl. I. figs. 4, 5, 6, 7.

26, 27. Young condition of the knob. *t. vs.* Embryonic vesicle, resembling the terminal vesicle of the adult knob in *Agalma.* This is reduced in size, and lost in the adult *Physophora.* θ. Enlargement of the cavity of the knob, which later grows into a canal (*cn.*) along the side of the coiled part of the adult knob. λ. Point of origin of the coiled part of the knob.

28. In this figure the vesicle (*t. vs.*), formerly terminal, has become lateral (*l. vs.*), and the cavity (θ) has been elongated into a canal (*cn.*) by the growth of the point of attachment of the coiled part of the knob to the pole opposite its peduncle, or attachment to the tentacle. *iv.* Involucrum. *sac.* Sacculus.

29. Knob similar to that of the adult. The lateral (embryonic) vesicle is lost, the canal (*cn.*) tube-like, and the attachment (λ) of the sacculus to the inner wall of the involucrum at the opposite pole to that where it formerly hung.

PLATE VIII.

Development of the Acraspeda. *Figures from* Louis Agassiz.

B. *bl p.* Blastopore.
C. *can. crc.* Circular Canal.
con.[1]—*con.*[3] Constrictions which ultimately become deep enough to separate the intermediate disks as Ephyræ from the Strobila.
E. *e b.* Epiblast.
G. *ga.* Stomach.
gm. Bud.
ga c. Portion of the stomach, which forms a dish-shaped cavity, as distinguished from that within the oral folds.
L. *lab.* Hypoblast.
H. *h b.* Lip of oral tentacle.
M. *man.* Manubrium.
N. *ncl.* Nucleolus.
nl. Nucleus.
O. *oa.* Ovary.
o cy. Otocyst.
o cy. lb. Otocyst lobe.
o cy. s. Style bearing the otocyst.
or. Mouth.
or.[1] Mouth.
or. ta. Oral tentacle.
P. *p.* Posterior pole of the planula.
py. gm. Bud forming on the side of the Strobila.
T. *ta.* Tentacle.
ta.[1] Tentacle of the Scyphostoma.
ta,[3] *ta.*[4] Undeveloped tentacle.
tb. Enlargement of circular canal at the junction of the ocular tube.
tb.[1] Tube passing radially from stomach to vicinity of sense organ, opening at the periphery into the enlargement (*tb*) and centrally into radial tube (*tb*[3]).
tb.[2] Tube passing directly from stomach to bundle of tentacles.
tb.[3] Tube from stomach in sense octant, before division.
tb.[4] Centripetal tube arising from circular canal at the peripheral end, ending blindly at the other extremity.
tb.[5] Tube in the lappets of the otocyst (?).
tb.[6] Angle in tube (*tb*) which later pushes itself into the lappet.
U. *ubr.* Umbrella.
V. *vel.*, *vel.*[1] Velum.
vt., *vt.*[1] Vitellus.
vt. m. Vitelline membrane.
α. Rim of the orifice leading into ovarian cavity.
β. Base of attachment, also abnormal unattached bases.
β.' Base of a Strobila with large number of constrictions.
γ. Chitinous basal support (perisare ?)
ζ,ζ.' Gelatinous portion of the umbrella between two chymiferous tubes.
φ. Phacellen (sexual filaments).
φ.' Phacellen, seen through the ovarian opening.

The figures on this plate were arranged by A. Agassiz.

1–9. *Aurelia flavidula*, from Agassiz, *op. cit.*, Vol. III. Pl. X. figs. 1, 2; Pl. X[a]. figs. 16, 17, 19, 20, 22, 23, 24.

1–21. Development of the planula from the ovum.

1, 2. Ovum (life-size) from ovary. The early conditions are passed through in the ovary and folds of the mouth.
3. Enlarged view showing the yolk cells in the middle of the ovum.
4. The vitelline cells occupy the whole vitellus (*vt*).
5–8. Consecutive stages, with nucleus (*nl*) and nucleolus (*ncl*). *vt.*, *vt.*[1] Vitellus. *vt. m.* Vitelline membrane.
9. Morula. *nl.* nucleus. *vt.* Vitellus.

10–20. Acraspedote medusa, Genus ? These figures resemble the stages of segmentation of *Cyanea*. They illustrate the formation of a blastosphere (fig. 20) from an egg where segmentation has just begun.

18–19. Optical sections showing a segmentation cavity. After fig. 20 is reached, the outer wall (epiblast?) — there is but a single wall to the blastosphere — of the blastosphere folds inward, forming in *Chrysaora* a gastrula.

21–49, from Agassiz, *op. cit.*, Vol. III. Pl. X. figs. 4, 4ª, 10, 10ª, 12, 14, 14ª, 14ᵉ, 19, 26, 35, 36ª; Pl. Xª. figs. 2, 4, 10, 11, 13, 19, 22, 25, 28; Pl. XI. 6, 19, 20, 29; Pl. XIᵇ. figs. 5, 10, 16, 17, 20.

21–33. Development of the Scyphostoma from the planula.

21. Planula of *Aurelia*.
22. Pyriform planula with a blastopore (*bl p.*), In *Chrysaora*, according to Claus, after the formation of the gastrula the blastopore closes, forming a closed sac. In Agassiz's figures it remains open, and forms the mouth of the Scyphostoma. The relationship of the mouth and inner cavity of the gastrula remains doubtful. *p.* Pole opposite the blastopore.
23. Still more elongated planula, resembling that of the *Hydroida*. *bl p.* Blastopore. *p.* Posterior pole.
24. The planula has attached itself at *β*, and beginnings of several organs of the Scyphostoma have appeared. *bl p.* Blastopore. *e b.* Epiblast. *ga.* Stomach cavity known as stomodæum. *h b.* Hypoblast (In *Chrysaora* infolded epiblast of the blastosphere forms the hypoblast), whose origin in this genus is unknown. *ta.* Tentacles.
25–26. Two other attached planulæ. Fig. 25 has a wide-open blastopore (*bl p*) leading into the stomach (*ga*), and fig. 26 retains its cilia. *γ.* Ring of perisarc at the base of attachment.
27. Fixed larva with two tentacles (*ta*¹) and mouth (*bl p*). *e b.* Epiblast. *h b.* Hypoblast.
28. An abnormal attached larva. *bl p.* Blastopore. *e b.* Epiblast. *ga.* Stomach. *h b.* Hypoblast. *β.* Base of attachment.
29. Scyphostoma with four tentacles. *bl p.* Mouth. *ga.* Stomach. *ta.*¹ Tentacles. In *Chrysaora*, between this stage and a following, there form in the cavity of the stomodæum in intermediate planes as respects the tentacles four ridges, thickenings of the hypoblast, which grow in such a way as to divide the cavity into four chambers, as in a young Actinozoan.
30. Older Scyphostoma. *bl p.* Mouth. *e b.* Epiblast. *h b.* Hypoblast. *β.* Basal attachment. Tentacles probably solid hypoblast.
31. Scyphostoma with eight tentacles. *bl p.* Mouth. *e b.* Epiblast. *ga.* Stomach. *h b.* Hypoblast. *β.* Attachment. *γ.* Perisarc.
32. Scyphostoma with mouth (*or*¹) mounted on a protuberance rising in the midst of the circle of tentacles (*ta*¹). The oral region is bent over towards the observer, in order to show the oral prominence.
32.¹ Nematocyst from tentacle.
33. Scyphostoma seen from the side. *bl p.* Mouth.

34–40. Development of the Ephyra from the Strobila.

34. A Strobila with its first constriction (*con*¹).
34′. Attached larva with a bud (*gm*) from its base.
35. A larva beginning its second constriction (*con*²). *con.*¹ First constriction. 1-2. Disks constricted from the Strobila, later to separate from the fixed larva as Ephyræ.
36. A larva beginning a third constriction (*con*³). *con.*¹ First constriction. 1–3. Constricted disks. *ta.*¹ Tentacles. *β.* Base of attachment, and appendages near by.
36′. A deformed Strobila.
37. Upper portion of a Strobila with five constrictions (1–5). *o cy.* Otocysts (?). *or.* Mouth. *py. gm.* Bud from the side of the body. *ta.* Tentacle. *β.* Base near attachment.
38. Showing a Strobila just breaking its attachment of the Ephyra, whose umbrella (*ubr*) is reversed. The axial attachment (*man*) becomes the manubrium of the Ephyra below it. 1–3. Three attached Ephyræ. *or.* Mouth. *ta′.* Tentacles not the same as *ta* (*fig.* 27). *β.* Base.
39. A Strobila with its second row of tentacles (*ta′*) present and the transitory tentacles of the Scyphostoma dropped. There are 13 (1–13) constricted disks, of which the upper (1) is the oldest. *o cy.* Otocyst. *o cy. lb.* Otocyst lobe. *ta.* Position of future tentacle. *ta′.* Second set of tentacles. *β.* Base.

40–49. The Ephyra.

40. An Ephyra in youngest condition, derived from a strobila with "false" deciduous tentacles, and probably the first disk to fall off. *o cy.* Otocyst. *o cy. lb.* Otocyst lobe. *ta.* The longer of the appendages marked *ta* is probably a "false" tentacle, which has not yet fallen off. The other may be the true Ephyra tentacle. *ubr.* Umbrella.
41. Profile view of an Ephyra in which the mouth (*or*) with its lips, and the veil (*vel*)? are well developed. *man.* Manubrium. *o cy.* Otocyst. *ubr.* Umbrella.

42. Ephyra with umbrella (*ubr*) thrown back, leaving the manubrium (*man*) projecting outward. *ga. c.* Gastric chamber (in this early stage only a part of the stomach). *o cy.* Otocyst. *tb.* Tube to the otocyst from the gastric chamber. *tb.*[1] Tube from the gastric chamber to the region from which the tentacles later arise.
43. Ephyra of about the same age as the last from the aboval side. *ga. c.* Gastric chamber. *or.* Mouth seen through the body walls. *tb.*[1] Tentacular tube. *tb.*[2] Tube to the otocyst.
44. An older Ephyra seen from the oral side. *ga. c.* Gastric chamber. *o cy.* Otocyst. *or.* Mouth. *tb.*[1] Tentacular tube. *tb.*[2] Ocular tube. *ubr.* Umbrella.
45. A sense octant (from oral side) of an Ephyra of about this age. *o cy.* Otocyst. *o cy. s.* Stalk upon which the otocyst is carried. *tb.*[1] Chymiferous tube from gastric chamber to the region of the bell margin from which the tentacles arise. *tb.*[2] Tube to the peduncle of the otocyst. *tb.*[5] Blindly ending tube. *tb.*[6] Enlargement of ocular tube.
46. Quadrant of an Ephyra (oral view), older than the last in which the clusters of tentacles are formed. *can. crc.* Circular canal. *ga.* Stomach. *lab.* Lips. *oa.* Ovary. *o cy.* Otocyst. *or.* Mouth. *ta–ta.*[6] Tentacles. *tb–tb.*[6] Chymiferous tubes. *vel.* Velum. *ζ*, *ζ.′* Intervals of muscular lower floor separating tubes. The circular muscles are seen at *ζ.′*

46.[1] Ovarian opening. *oa.* Ovary. *γ.* Portion of bell-wall near ovary. *α.* Rim of opening. *φ.* Phacellen (sexual filaments). *φ.′* Phacellen, seen through opening.

47. Profile view of a young medusa, older than the Ephyra strictly so called, with bell expanded. *o cy.* Otocyst. *or.* Mouth. *or. ta.* Oral tentacles. *ubr.* Upper side of the umbrella.
48. The same with bell-walls contracted. *or. ta.* Oral tentacles.
49. Oral view of a young medusa older than the Ephyra, but without tentacles.

PLATE IX.

Development of the Ctenophora. *Figures from* Alexander Agassiz, *and* Carl Chun.

B. *blp.* Blastopore.
E. *cb.* Epiblast (?) A superficial layer of "small cells."
cb.t. Tentacular bulb, an eminence formed in part of epiblast, which later develops into a tentacle.
G. *ga.* Stomach.
ga.[1] Stomodæum.
H. *hb.* Hypoblast.
L. *ltb.* Lateral tube.
O. *ocy.* Otocyst.
ol. Otolith.
or. Mouth.
P. *pig.* Pigment.
ppl. Layer of protoplasm (?)
S. *sph.* Funnel.
T. *ta.* Tentacle.
V. *vt.* Vitellus.
vt. cl. Vitelline cells, "cell masses."
ζ. External envelope.
η. Swimming flappers.
θ. Polar elevation of protoplasm (?)
ω. Prominences of the body walls on each side of the otocyst.

Figures 1–33 on this plate were arranged by A. Agassiz.

1–37. From Agassiz, Embryology of the Ctenophoræ, *Mem. Acad. Arts and Sciences*, Vol. X. No. III. Pl. I. figs. 1, 2, 4, 5, 8, 12, 17, 18, 28, 29, 31, 37, 38. Pl. IV. figs. 8, 19, 23, 25, 28, 32, 34, 38, 42, 45. Pl. V. figs. 1, 2, 3, 5, 6, 7, 12, 15, 18, 19, 26, 27, 29, 30.

1–8. *Beroë* (*Idyia*) *roscola.*

1. Ovum of *Beroë* just after fecundation. The ovum is surrounded by a transparent envelope (ζ). *ppl.* Layer of granular protoplasm. *vt.* Vitellus.
2. First change in the ovum by which the "germinal layer" is concentrated at and about one pole, "the formative pole" (θ). The envelope ζ is gone. *vt.* Vitellus.
3. Somewhat older ovum with a prominent projection of the protoplasm at the pole (θ). *vt.* Vitellus. If the eminence (θ) be seen from a plane at right angles to figure 3, two prominences appear.
4. An embryo in which the projection has increased in size, and been deeply divided by a transverse furrow. Each elevation is lettered *cb.*[1] *vt.* Vitellus.
5. The furrow has deepened in this stage, so that the yolk is divided into two masses. The protoplasmic superficial layer extends over and surrounds them both. The deep slit is the position of a gastric cavity (*ga'*). *cb.* Epiblast (?)
6. The "bent dumb-bell stage," in which there are four yolk masses, the additional pair formed from the last by a fresh plane of segmentation. The pairs last formed are united by a bridge, as shown in the figure.
7. Embryo with four large vitelline masses, which will hereafter be lettered *vt. cl.*, and as many epiblastic prominences (*cb*).
8, 9. Dumb-bell stages of *Pleurobrachia rhododactyla*, seen from oral side, divided into eight vitelline masses. *cb.* Epiblast. *vt. cl.* Vitelline cells.
10. *Beroë roscola*, "Side view of (the) yolk-mass, in which the actinal segmentation of the smaller cells has commenced to form sixteen unequal masses." Agassiz.
11. An embryo with smaller spheres (*cb*) more numerous. *vt. cl.* Vitelline spheres.
12. "Yolk-mass seen from the actinal pole; the masses are arranged round a vertical axis, each small mass forming a small overhanging projection, at the extremity of which the germinal layer is concentrating, preparatory to a rapid segmentation, to be accomplished as in earlier stages of segmentation." Agassiz. *cb.* Epiblast. *ga.*[1] Gastrula cavity. *vt. cl.* Vitelline cells.
13. Embryo in which the smaller cells of the outer layer have undergone further division.

14–37. *Pleurobrachia rhododactyla.*

14. Embryo of *Pleurobrachia* of about the same age, showing the relative position of the larger and smaller cells.
15. A view of the same from the (oral ?) (actinal) axis. There is a confusion in different authors as to these two regions of the embryo.
16. Older embryo of *Pleurobrachia*, showing the "actinal trench" (?) in profile. *e b.* Epiblast. *ga.*[1] Gastric cavity. *vt. cl.* Vitelline masses.
17. A schematic section, showing the relation between the cavity *ga*,[1] the layer of small cells *e b*, and the vitelline masses (*vt. cl.*) *bl p.* Blastopore.
18. Embryo of *Pleurobrachia*, seen from the pole on which the blastopore (*bl p*) opens. *e b.* Outer layer of small cells.
19. An embryo of the same, of about the same age as the last, seen from the opposite pole. *e b.* Small cells. *vt. cl.* Large cells.
20. Morula in which the small cells have almost completely enveloped the vitelline masses.
21. An embryo showing the first elevation of epiblastic cells to form an otocyst (*o cy*). *e b.* Epiblast. *vt. cl.* Vitelline cells.
22. Embryo older than the last, showing an infolding of the outer walls to form a stomach (*ga*). *e b.* Epiblast. *e b. t.* Prominence of the epiblast at the points where the tentacles later appear.
23. An embryo of about the same age as the last, seen from the actinal pole (*o cy*).
24. Profile of the embryo in which the stomach cavity has formed. From A. Agassiz's account it seems that a part at least of the gastric cavity is hollowed out among the vitelline cells. This is the region of the funnel or the upper part of the cavity (*ga*). The lower portion or the true stomach is formed as a gastrular invagination of the epiblast. As interpreted by Balfour, the alimentary canal of the Ctenophore would be made up of two sections: (1) a true hypoblastic section, consisting of the infundibulum, and the gastro-vascular canals derived from it; and (2) an epiblastic section — the stomodæum — forming the stomach.
25. Older larva in which four otoliths (*ol*) have formed. *e b. t.* Tentacular prominence. *η.* Row of vibratile flappers.
26. The same, a little older, seen from the actinal pole. *ol.* Otolith.
27. Still older embryo. *e b. t.* Tentacular prominence. *ga.* Stomach. *ol.* Otolith.
28. Older larva. The otocyst is well formed, and the first of the two sections of the alimentary canal, mentioned above, has begun to have definite walls. *ga*, Stomach.
29. View of a larva younger than the last, seen from the actinal pole. *eb. t.* Tentacular prominence. *ol.* Otolith.
30. An older larva with tentacles still more developed. Otoliths (*ol*) brought close together into an otocyst (*o cy*). *ta.* Tentacle.
31. Still older larva, seen from one side, in which the tentacles are well formed. *ga.* Stomach. *sph.* Funnel.
32. Older larva. *ga.* Stomach. *sph.* Funnel. *ta.* Tentacle. *η.* Row of locomotive flappers.
33. View of a slightly older larva showing a tentacle on the middle line. *or.* Mouth. *η.* Row of locomotive flappers.
34. More advanced embryo. *or.* Mouth. *η.* Vibratile flappers.
35. Side view of a larva a little older than the last. *ga.* Stomach. *o cy.* Otocyst. *ol.* Cluster of otoliths. *ta.* Tentacle.
36. More mature embryo than the last (side view). *ga.* Stomach. *or.* Mouth. *ta.* Tentacle. *η.* Vibratile flappers.
37. The same in another plane. *ga.* Stomach. *or.* Mouth.

38–40. *Callianira bialata*, Delle Chiaje, from Carl Chun, Fauna und Flora des Golfes von Neapel, I. Monographie: Ctenophoræ. Pl. III. figs. 1, 2, 3.

38. Larva before the formation of the lobes of the body on each side of the otocyst.
39. Side view of the same or an older larva. *ga.* Stomach.
40. An older larva, with beginnings of the wing-like extensions of the body (*ω*). *l. th.* Lateral tube. *η.* Vibratile flapper.

41–45. From Chun *op. cit.* Pl. VII. fig. 18. Pl. III. fig. 8. Pl. VIII. fig. 8. Pl. XIV[a]. figs. 9, 10.

41. Larva of *Chiaja* (*Eucharis*) *multicornis*. *h b.* Hypoblast. *η.* Position of the vibratile flappers. The thin layer which embraces the whole embryo is the epiblast, and the infolded region at the lower pole is the future mouth. Rows of combs should be represented at *η*, and on the corresponding opposite side, while a line indicating the lower edge of the mouth should connect the two prominences at the lower pole.
42. Embryo of *Beroë Forskålea*, Chun (optical section). *e b.* Epiblast. *h b.* Hypoblastic cells. *or.* Mouth. *sph.* Lumen of the hypoblast. This cavity in the centre of the larva is the beginning of the future funnel. *η.* Row of vibratile flappers. *o cy.* Otocyst.

43. Larva of *Hormiphora plumosa*, *gen.* Ag. *sp.* Sars. *ga.* Stomach. *l.tb.* Lateral tube. *o cy.* Otocyst. *or.* Mouth. *sph.* Funnel.
44. Embryo of *Beroë rufescens*, Forsk. (*Forskâlea*, Chun.) *l. tb.* Lateral tube. *ol.* Otolith. The otocyst is not yet formed about the otolith. *or.* Mouth.
45. Larva of the last named, which has reached sexual maturity. *ol.* Otolith already enclosed in its otocyst. *or.* Mouth. *pig.* Pigment.
46. *Beroë roscola*, from Agassiz, *op. cit.* Pl. III. fig. 18. Embryo seen from "abactinal" pole. *ol.* Otolith. *η.* Row of vibratile flappers.
47. *Beroë rufescens*, from Chun, *op. cit.* Pl. XIV[a]. fig. 11. Larva seen from one side. *o cy.* Otocyst. *or.* Mouth. *tb.* Chymiferous tubes.

48–50. *Beroë roscola*, from Agassiz, *op. cit.* Pl. III. figs. 19, 20, 22.

48. Larva somewhat older than that shown in figure 47, in which the two chymiferous tubes, under the combs nearest the medial line of the figure, have pushed their way to the vicinity of the mouth. *ga.* Stomach, which occupies the whole body cavity. *or.* Mouth. *η.* Vibratile flappers.
49. View of an older larva, seen at right angles to the last. The two tubes, which in fig. 48 were represented as approaching the mouth, have in this united, forming a ring about it. The other tubes are advancing to the labial region. *ga.* The whole cavity of the larva forms a stomach; the portion marked (*ga*) one of the tubes of the body walls. *o cy.* Otocyst. *η.* Vibrating flapper.
50. Larva of *Beroë roscola*. *ga.* Stomach. *o cy.* Otocyst.

PLATE X.

Development of the Ctenophora, *continued. Figures from* Carl Chun *and* J. Walter Fewkes.

A. *adr. tb.* "Adradial" chymiferous tube. The adradial tube passes to the short rows of flappers. It arises from the interradial tube.
aur.[1]–*aur.*[4] Auricles.
C. *cil.* Cilium.
cil'. Tuft of cilia before closure of otocyst.
E. *ex*[1]., *ex.*[2] External openings from the funnel, probably excretory.
ex. l. tb. External lateral tube bounding the lower rim of the body lobes (*lb*).
G. *ga.* Stomach.
ga. cn. Bifurcation of the stomach tube.
ga. sch. Magengefässschenkel.
ga. tb. Stomach tube.
gaw. Appendage to the stomach.
H. *h b.* Hypoblast.
h b.,[1] *h b*[2]. Large hypoblast cells.
h b[3]., *h b*[4]. Beginning of the chymiferous system of vessels.
I. *i.l.tb.* Internal lateral tube.
i.r.tb. Internal radial tube.
L. *lb.* Body lobes.
l.mu. Lateral muscles.
M. *mg.w.* Median gelatinous prolongation near the otocyst.
mu. Muscles.
mu.crc. Muscles surrounding the stomach.
N. *n.*–*n.*[8] Nerves.
n c. Nerve centre
O. *o cy.* Otocyst.
ol. Otolith.
or. Mouth.
P. *per. cn.* Radial canal before division.
S. *sch.* Tentacular cover.
s.g w. Gelatinous elevations on the side of the otocyst.
sph. Funnel.
sph. tb. Tubular region of the funnel.
T. *tn.* Tentacle.
tb.–*tb.*[8] Chymiferous tube extending to the tentacle.
X. *x.* Junction of three chymiferous tubes.
Y. *y.*[2], *y.*[3] Line of the internal wall of the lobe at the point where the chymiferous tubes seem to cross it.
Z. *z.*[1]–*z.*[4] Junction of tubes at base of auricles.
η.–*η.*[8] Vibratile flappers.
θ. Simple division of chymiferous tubes without tentacle in genus *Ocyroë*.

1–19. From Chun, *op. cit.*, Pl. II. figs. 9, 10; Pl. VII. figs. 1, 4, 6, 11; Pl. VIII. fig. 4; Pl. IX. figs. 3, 4, 8, 15, 16; Pl. XII. 3, 4, 6, 7, 8, 11.

1–10. Development of *Chiaja* (*Eucharis*) *multicornis*.

1. Segmented ovum, showing the larger cells, "vitelline cells" within, surrounded by smaller cells of epiblast. The opening through which the larger cells appear is a blastopore.
2. Embryo in which the epiblastic cells have almost completely closed the opening (*blp*) seen in figure 1. The remains of this orifice appears as a long narrow slit.
3. Optical section of the gastrula.
4. The gastral mouth now completely closes, and the wall of the epiblast begins to infold to form the future mouth and stomach.
   Embryo in which this infolding has assumed considerable size, and in which, also, the tentacular prominences (*tn*) have begun to form. An otocyst is already formed, while a single otolith is represented in Chun's figure, which has not yet grown into the otocyst. The investing layer is the epiblast. *h b.* Endoderm, hypoblast. At the point *mu.* is the beginning of the muscular layer which later becomes very prominent. *η.* Vibratile row of flappers. *cil'.* Tufts of cilia.
5. Still older larva in which the size of the layer between the outer thin epiblast and the larger cells, hypoblast (*h b*[1]., *h b.*[4]), has increased greatly in size. In the latter the star-like muscular cells can be seen.

This layer is an enormous growth of the layer designated by the letters *mu.* in figure 4. *cil'* Cilia at the actinal pole. *or.* Mouth. *ta.* Tentacle. At $h\,b.^3$, $h\,b.^4$ begin to arise saes, which later develop into the circulatory-tube system. The tube $h\,b.^3$ is best marked of these. $h\,b.^1$, $h\,b.^2$ Remains of the original large cells.

6. Sexually mature, "Cydippe-formed larva," of *Chiaja* (*Eucharis*). At the peripheral extremity of the eight tubes (*adr. tb.*) are swollen cavities, filled with sexual products. These lie just beneath the rows of combs or vibratile flappers. *adr. tb.* Adradial tube, ultimate division of the chymiferous tubes, which extend to a meridional tube below the rows of flappers. *ga.* Stomach. *ga. tb.* A chymiferous tube, in this stage ending blindly in the bell-walls, and called the stomach tube from its relation in position to the stomach. *i.r.tb.* Internal radial tube. There are four of these which arise from the base of the funnel and each divides into two adradial tubes (*adr. tb.*). $n.^4$, $n.^5$ Nerves. *sph. tb.* Tube of the funnel, which spreads itself out at the upper pole (*sph. tb.*) under the nerve centre (*n c.*) Above the nerve centre is the otocyst with its otoliths.

7 A larva at about the same stage, seen in a plane at right angles to the last. *ga.* Stomach, here seen in profile. *adr. tb.* Adradial tube. *ga. tb.* Stomach tube arising from the funnel (*Sph.*). *i.r.tb.* Internal radial tube. $n.^2$, $n.^3$ Nerves. *n.c.* Nervous centre. *ta.* Tentacle. *ta. tb.* A tube, which passes directly to the tentacle from the funnel. $tb.^2$ A blindly ending, meridional tube under a row of vibratile flappers. $\eta.^4$ Row of flappers. *lb.* Rudimentary lobes.

8. View of a Cydippe-like larva of *Chiaja* (*Eucharis*) from the actinal pole. *adr. tb.* Adradial tube. *ex.*,[1] *ex.*[2] Excretionary (?) opening. *ga.* Stomach. *n.* Nerve. $tb.$–$tb.^8$ Chymiferous tubes. *per. cn.* Canal arising from the base of the funnel before its division into the interradial tubes. *ta.* Tentacle.

9. Somewhat older larva from the actinal pole, in which the chymiferous tubes have joined in the bell-walls. *adr. tb.* Adradial tube. $aur.^1$–$aur.^4$ Auricles. *ex. l. tb.* Tube skirting the lobe of the body, outside the internal tube (*il. tb.*). *ga.* Stomach. *ga. sch.* Magengefässschenkel. *ga. tb.* Gastric tube seen in section. *i.r.tb.* Internal radial tube. *ta.* Tentacle. $z.^1$–$z.^4$ Point of bifureation of the tube which skirts the auricle.

10. The same seen from the side. *adr. tb.* Adradrial tube. $aur.^1$, $aur.^2$ Auricles. *ex.l. tb.* External tube of the body lobe. *ga.* Stomach. *ga. sch.* "Magengefässschenkel." *gaw.* Sac-like appendage to the stomach. *i. r. tb.* Internal radial tube. *lb.* Body lobe. *mg. w.* Medial gelatinous elevation near the otocyst. *n.* Nerve. *ocy.* Otocyst. *ta.* Tentacle. *tu. tb.* Tentacular tube. $y.^2$, $y.^3$ Inner wall of the body lobe, seen in profile. $\eta.^3$–$\eta.^6$ Rows of vibratile flappers.

11–17. Development of *Cestus Veneris.*

11. Young larva of *Cestus*, seen from one side. *ga.* Stomach. *ga. tb.* Tubes one on each side of the stomach. $n.^1$–$n.^4$ Nerves. *or.* Mouth. *sph. tb.* Tube of the funnel. $tb.^1$–$tb.^4$ Chymiferous tubes. $\eta.$ Vibratile flapper.

12. View of the "Cydippe-formed larva" from the actinal pole. *ga.* Stomach. *ga. tb.* Stomach tube. *i.r. tb.* Internal radial tube. $n.^1$–$n.^8$ Nerves. *mu.* Muscles. *ol.* Otolith. *per. cn.* First division of the chymiferous tubes. *ta.* Tentacle. $tb.^1$–$tb.^8$ Chymiferous tubes.

13. Still older larva ("Cydippe form"). *ga. tb.* Stomach chymiferous tubes. *mu. crc.* Circular muscles. $n.^1$–$n.^4$ Nerves. *ocy.* Otocyst. *or.* Mouth. *sph.* Funnel. *sph. tb.* Tube of the funnel. *ta.* Tentacle. $tb.^1$–$tb.^4$ Chymiferous tubes below the flappers. These have begun to extend downward, but in this stage are blind ending.

14. Larva of "Cydippe form" in which the tubes (*tb.*) have grown downward towards the oral pole. (View at right angles to fig. 13.)
adr. tb. Adradial tube. *ga.* Stomach. *ga. tb.* Gastric tube. *ga. cn.* Beginning of a bifurcation of the extremity of the gastric tube. *n. c.* Nervous centre. *sph.* Funnel. *ta.* Tentacle. *sph. tb.* Tube passing from the funnel to the otocyst. *tb.*, $tb.^3$–$tb.^6$ Chymiferous tubes, extending meridionally in the bell-walls. $\eta.^5$, $\eta.^6$ Vibratile flappers.

15. Older larva than that known as the "Cydippe form" (seen in the same plane as fig. 14). *ga.* Stomach. *ga. tb.* Gastric tube. *ga.* Sac-like appendage to the stomach. *m.gw.* Gelatinous elevation near the otocyst. *n.* Nerve. *ocy.* otocyst. $tb.^3$ Chymiferous tube formed by the junction of two opposite tubes (*tb.*, and $tb.^6$, fig. 14). $tb.^4$, $tb.^5$ Two chymiferous tubes.

16. An older stage in the development in which the chymiferous tubes ($tb.^4$, $tb.^5$) have joined $tb.^3$ at $x.^2$, $x.^3$ *ga.* Stomach. *i.r.tb.* Internal radial tube. *sph. tb.* Tube of the funnel.

17. Older embryo, in which the larva has become more elongated and band-shaped.

18, 19, *Thoë paradoxa*, Chun.

18. Larva (?) of *Lampetia pancerina*, Chun, with single tentacle (view showing the tentacle on one side). *ga.* Stomach. *n c.* Nervous centre. *sch.* Tentacular sheath. $\eta.^1$–$\eta.^4$ Rows of vibratile flappers. $tb.^3$, $tb.^4$ chymiferous tubes under flappers $\eta.^3$ and $\eta.^4$

19. The same larva seen at right angles to the plane of the last. *ga.* Stomach. *ga. w.* sac-like gastral appendage. *n c.* Nerve center. *sph.* Funnel. *sch.* Tentacular sheath. *ta.* Tentacle. *ta. sac.* Tentacular sac.

20. Larva of *Oxyroë crystallina* Rang, from Fewkes, Notes on Acalephs from the Tortugas, with a Description of New Genera and Species. *Bull. Mus. Comp. Zool.* Vol. IX. No. 7. Pl. 1. fig. 2. *adr. tb.* Adradial tube. *aur.*,[1] *aur.*[2] Auricles. *ex.l.tb.* External lateral tube. *ga.* Stomach. *ga. tb.* Gastric tube. *i.l.tb.* Internal lateral tube. *lb.* Lobe of the body out-stretched. *l.mu.* Muscles. *ocy.* Otocyst. *or.* Mouth. *sph. tb.* Tube extending from the funnel to the otocyst. *η.* Vibratile flapper.

PLATE XI.

Development of Zoantharia (Actininæ). *Figures from* Henri de Lacaze-Duthiers, A. O. Kowalevsky, Étienne Jourdan, Oscar Hertwig und Richard Hertwig, *and* Angelo Andres.

bl d.	Blastoderm.	*om.*	Ovum.
cil.	Cilia.	*or.*	Mouth.
ec.	Ectoderm.	*pes.*	Foot.
en.	Entoderm.	*phx.*	Pharynx.
g.	Germ.	*phx. sac.*	Pharyngeal sac.
g. vs.	Germinative vesicle.	*phx. sul.*	Pharyngeal groove.
lg. mu.	Longitudinal muscles.	*sg. cav.*	Segmentation cavity.
mb. pa.	Membrana propria.	*ta.*	Tentacle.
m nt.	Mesenteries.	*tc. cap.*	Testicular capsule.

Arabic numerals are used to indicate the order of appearance of the mesenteries.

The Greek letters show the order of the formation of mesenterial chambers and the order of the succession of the tentacles up to the stage with 12.

1–25. *Actinia mesembryanthemum.* From Lacaze-Duthiers, Développement des Coralliaires. Premier mémoire. Actiniaires sans polypier. Arch. de Zool. exp. et gén., Tom. I. 1872. Plates XI.–XIII.

1. A portion of an exclusively female mesenterial fold or septum, showing eggs with the germinative vesicle, and also dark, deeply colored germs no longer possessing a germinative vesicle.

   Note.—In the original, more extensive, figure the eggs are shown to be often arranged in series. In the opinion of the author, this appears indicative of their common origin.

2. A highly magnified spermatozoön.

2a. Cells from the interior of a testicular capsule, in the condition in which they are found when they are mingled with mature spermatozoa.

3. One of the reniform testicular capsules from a male mesenterial fold, rupturing and allowing the escape of a stream of spermatozoa. $\frac{5}{1}\frac{0}{0}$.

4. A germ at the time of its escape from the ovary. It appears bristling with prickles, which it afterwards loses.

4a. Portion of the external layer of the same, more highly magnified. $\frac{5}{1}\frac{0}{0}$.

5. (At the bottom of the plate near the middle.) A germ in which there is a central deeply-stained mass (entoderm), and a peripheral layer (ectoderm) scarcely rose-colored. The depression which will be the mouth is indicated by *or*. The cilia are more strongly developed at the aboral pole. The striate appearance of the outer layer is caused by the presence of nematocysts which have begun to be developed in it, as well as by the cilia. About $\frac{1}{1}\frac{7}{5}$.

6. An embryo seen in profile, and already presenting one partition (septum) indicated by a vertical line.

7. The same as the last; view of the oral pole. The mouth is elongated in the manner of a button-hole, the long diameter of which is perpendicular to the two septa, marked 1, which have divided the central mass of the embryo into unequal portions, α and α′.

8. A slightly more advanced embryo seen from the side. The partitions, and especially the œsophageal prolongation, cause the appearance at this point of the transversely oval cavity.

9. A more advanced embryo, in which a second pair of partitions, 2, are visible.

10. Embryo showing plainly the division into four compartments. The chamber α′ is already removed from the partition, 1, which gave origin to it; the chambers β, β form with α′ a group of three lobes representing the greater of the two original chambers.

11. The same as fig. 10, seen in profile. The œsophagus (pharyngeal sac) descending from the mouth is already well formed, and the chambers to the number of four are also well limited.
12. An embryo much larger than the preceding. The small compartment (α) is divided into three by the pair of partitions, 3. The compartment β of fig. 10 is also divided already into two (β and δ) by the appearance of the partition, 4. Of the 8 septa thus acquired, the pairs numbered 1 and 2 are always more developed than the others.

    Note. — The order of development of the "septa" 2 and 4 is claimed by the brothers Hertwig to have been interchanged, so that the true order of their appearance would be indicated by the numbers in parentheses. Compare explanations of figs. 31, 35, and 36.
13. Profile view of the preceding, showing the mouth surrounded by 8 compartments with rounded bases.
14. The same as in the two preceding figures, but the progress of the partitions being more considerable, the division into 8 compartments is more distinct ; the partitions, 1, are still much more advanced ; they already reach the central pad surrounding the mouth (peristome), and consequently begin to indicate the primitive division into halves.
15. An embryo in which the 8 complete partitions have reached the peristome.
16. Embryo with 8 divisions showing the partitions, 5, well advanced, and the beginning of the partitions, 6, in the lobe γ. The two new chambers thus formed are respectively ε and ζ.
17. One of the various forms which the embryos assume when in motion.
18. The same as fig. 17. It has been compressed a little to show the "septa" or mesenterial folds (*m nt.*). Only two of the latter (1, 1) present the beginnings of the craspeda, or mesenterial filaments ; they are the primary folds. $\frac{7}{1}^{5}$.
19. An embryo represented with the form which it assumes when it swims rapidly. The tuft of cilia at the pedal pole is considerably elongated. $\frac{7}{1}^{5}$.
20. Profile view of an embryo. The mouth is supported on a snout-like prolongation, and the primitive chamber α′ has begun to send forth a tentacle. 1, Primary fold with mesenterial filament slightly developed. $\frac{7}{1}^{5}$.
21. Embryo further developed than the preceding, exhibiting already eight tubercles, which are the beginnings of the tentacles of the eight chambers first formed. $\frac{7}{1}^{5}$.
22. Oral aspect of a young actinia already approaching the form of the adult. The 12 tentacles of the first formation are already produced. The period of equalization in sixes, taken alternately, is in process of accomplishment and transforms the special embryonic form into one with regularly radial symmetry. The two cycles already begin to appear. The group of 7 lobes which has as its centre the tentacle α′ is always distinguishable by the size of the latter, and by the development of the mesenterial folds, 1. $\frac{2}{1}^{0}$.
23. Young actinia with two well-pronounced cycles. The limits of the pedal disk are well marked, although the movements of the animal are still very lively, and the tuft of pedal cilia is very long. $\frac{2}{1}^{0}$.
24. Young actinia already attached, viewed from the oral pole. In the intervals between the tentacles of the first cycle (α — ζ, ζ — ε (ζ — δ ?), δ — α′) there begin to be formed six new pairs of young tentacles, which increase the total number to twenty-four.

    Note. — Of the three tentacles occupying each of the intervals (α — ζ, ζ — δ, etc.) the *middle* one out-strips the other two, replacing (in size) γ, ε, β, etc., and thus the middle ones come to constitute the *second* cycle. The third cycle is then composed of the remaining 12 (smallest) tentacles, which occupy the intervals between those of the first two cycles, thus regularly alternating with them. The subsequent increase in the number of chambers — and later, in that of the corresponding tentacles — is accomplished by the production of a *pair* of elements (mesenteries) in each of the 12 chambers above which are placed the smallest tentacles ; and by a process of substitution similar to that just described the middle ones of the three compartments (tentacles) thus formed comes to constitute the third cycle, while the two on either side of it become members of the fourth cycle. The fifth cycle is formed in a similar manner. "Since after the formation of each fresh cycle, the arrangement of the tentacles again becomes symmetrical (in sixes), it is obvious that all the equal-sized cycles except the first are formed of tentacles entirely heterogeneous as to age."
25. Face view — from the side of the seven-chambered group — of a young actinia with twenty-four tentacles, showing the relative development of the three pairs of mesenterial folds, 2, 4, and 5. $\frac{2}{1}^{0}$.

26–31. *Actinia* (sp. ?). From A. O. Kowalevsky, Observations on the development of the Cœlenterata. From the Publications of the Imperial Society of Friends of Natural Sciences, Anthropology, and Ethnography. Moscow : Katkov, 1873. 4to, 36 pp., 8 pl. (Russian.) Pl. IV. figs. 1–5, 7.

26. The egg after its segmentation.
27. Infolding of the blastoderm.
28. Invagination completed.
29. Later stage in which the mouth-opening appears as a narrow slit and the first pair of mesenterial partitions has arisen.
30. Radial section of the germ which is represented in fig. 29.

31. Radial section of a more advanced germ. The pairs numbered (2) and (3) constitute the second series of mesenterial septa, the single septum, (4), arising later; a corresponding single septum (not shown in the figure) arises diametrically opposite (4).

    NOTE. — The numbers in parentheses indicate the order in which the brothers Hertwig claim that the septa must have arisen, the septum numbered (4) being in their opinion really a pair of septa. Compare figures 35 and 36.

32–34. *Actinia equina.* From Étienne Jourdan, Recherches zoologiques et histologiques sur les Zoanthaires du Golfe de Marseille. Ann. sci. nat., sér. 6, zool., Tom. X., Art. no. 1. Oct. 1880. Pl. XVI. figs. 117, 118, 120.

32. Longitudinal section, showing the secondary infolding to form the œsophageal tube (*phx*). $\frac{2}{1}\frac{3}{0}\frac{0}{0}$.
33. Transverse section of a stage with eight partitions (*m nt.*), of which the *membrana propria* forms the axes. $\frac{8}{1}\frac{0}{0}$.
34. Larva with small tentacles, *ta.*; *ec'*, ectoderm of the œsophageal tube. $\frac{1}{2}\frac{}{5}$. (Longitudinal section.)

35, 36. *Adamsia diaphana.* From Oscar Hertwig und Richard Hertwig, Die Actinien anatomisch und histologisch mit besonderer Berücksichtigung des Nervenmuskelsystems untersucht. Jena: Gustav Fischer, 1879. Taf. I. figs. 3, 4.

35. Cross section of a young Adamsia in which the fifth and the sixth pairs of "septa" are still destitute of muscle fibres.
36. Cross section of an Adamsia somewhat older than the preceding. The fifth and sixth pairs of septa, although exhibiting muscles, have not yet joined the pharyngeal tube.
    The Roman numerals indicate the ultimate grouping of the septa into pairs in the adult animal.
    The Arabic numerals are used to indicate the supposed order of appearance of the 6 primary pairs of septa, the 5th and 6th appearing, however, at the same time.
    The pairs numbered 3, 3, and 4, 4 are called "direction septa" by the Hertwigs.

37. Thirteen figures illustrating the scissiparity of *Aiptasia lacerata.* From A. Andres, Intorno alla scissiparità delle attinie. Mittheilungen a. d. Zoolog. Station zu Neapel, Bd. III., Heft 1. 9 Dec. 1881. Taf. VII.

    The letters correspond to the successive epochs of observation, as follows: *A.* 7 Nov. 9 A. M.; *B.* 7 Nov. 12 M.; *C.* 7 Nov. 12 : 20 P. M.; *D.* 7 Nov. 12 : 30 P. M.; *E.* 7 Nov. 12 : 40 P. M.; *F.* 7 Nov. 12 : 50 P. M.; *G.* 7 Nov. 1 P. M.; *H.* 11 Nov. 3 P. M.; *I.* 12 Nov. 3 P. M.; *J.* 19 Nov. 10 A. M.; *K.* 25 Nov. 3 P. M.

    The unaccented letters belong to figures giving the general aspect in profile. *B*, *D*, and *G* are natural size; *I* and *K*, magnified two diameters, represent only the newly-formed individual. The letters with a single-accent pertain to figures exhibiting the appearance of the base, and those with a double accent to figures of *radial* sections. *C'*, *E'*, and *G'* are magnified between 2 and 3 diameters; *H'* 5 diam.; *J'*, and *K'*, 6 diam.; *C''*, and *K''*, 15 diam.

    The parent has 96 mesenteries. Of the intermesenterial chambers the 12 primary are designated by the odd numbers from 1 to 23, the 12 secondary by the even numbers from 2 to 24, the 24 tertiary by the accented numbers 1', 2', 3', etc. (not reproduced here), and the 48 quaternary, or spurious, mesenteries are not numbered. Neither of the gonidial chambers is involved in the changes.

    At stage *B* the disk of the foot exhibits a gibbosity which is opaque at the margin. A radial longitudinal section shows in this stage, as also in the next (compare *C''*), that it is due principally to a thickening of the entoderm, which soon occupies all the available space in the chambers. (The ectoderm in *C''* has been drawn relatively too thick.) The region embraced in the gibbosity is embraced between the numbers 1 and 9.

    In the next stage (*C'* and *C''*) the gibbosity is distinguished from the rest of the periphery by two angles, which correspond to the two chambers 1' and 8'.

    In stage *D* the angles correspond to the chambers 2 and 8. The laceration of the mesenteries embraced between 3 and 7 now begins.

    In the succeeding stage (*E'*) upon the base the laceration is completed in the median space, and is also extended to the chambers 4 and 8, nearly isolating the gibbosity, which now remains attached by only two delicate cords, — remnants of 3' and 8'. The ragged edges contract toward the principal mass, whether of the parent or the off-shoot, gradually determining the contour.

    The final separation (*G'*) is effected at points corresponding to 2' and 8'. The process thus far has occupied only one hour.

    Four days later (*H'*) the basal portion of the parent shows the arrangement of restored mesenteries and chambers, and the contour shows that the scar is healed. The off-shoot is thickened and rounded; the mesenteries at its extremes are fused together into a uniform obscure mass. The chambers which persist are 3, 3', 4, 4', 5, 5', and 6, together with the intervening ones. A sagittal section perpendicular to the plane of separation shows that the off-shoot has an opening where its continuity with the parent was severed. This opening is restricted by the margins of the internal parts, which tend to curve inward at all points and,

being more pronounced below than above, carry the aperture obliquely upward (compare *K''*). Some of the mesenteries are clearly prolonged from the curved portion of the periphery across to the straight — or chord — portion corresponding to the line of separation. The latter side subsequently assumes the appearance of a hilus.

A view of the base eight days later (*J'*) shows it almost completely rounded, and in the region of the former hilus the formation of two new chambers is confusedly indicated. It is to be seen upon sagittal sections that in the region of the hilus some of the mesenteries are certainly formed by the development of the distal portion of the central mesenteries of the opposite or curved side, others by the regular growth of the mesenteries occupying the folded ends of the off-shoot, and still others by a new local origin; also that the infolded portions previously mentioned gradually come to form the pharynx.

At length, after six days more (*K'*, *K''*), the off-shoot is developed into a minute young actinia with nearly central mouth and twelve tentacles. Upon the base are readily recognized six primary chambers (1–6), — of which 4 are old and 2 are new, — 6 secondary, and 12 spurious chambers. The gonidial chambers correspond to 1 and 4.

A few days later it had become quite regular, and showed traces of eraspedi (mesenterial filaments) on the gonidial mesenteries.

PLATE XII.

Development of Zoantharia *and* Alcyonaria. *Figures from* A. O. Kowalevsky, Étienne Jourdan, Wilhelm Busch, Alexander Agassiz, Edward L. Mark *and* Carl Claus.

an. po.	Anal pore.
bl d.	Blastoderm.
cam.	Artificial chamber between *cc.* and *en.*
cil.	Cilia.
d.	Dorsum, and dorsal mesenteries.
d.–l.	Dorso-lateral mesenteries.
dx.	Dextral.
cc.	Ectoderm.
en.	Entoderm.
en′.	Intermesenterial ridges of *en.*
gtt. ol.	Oil globules.
lab.	Oral lips.
lg. mu.	Longitudinal muscles.
lg. mu′.	Longitudinal muscles of mesenteries.
mb. pa.	Membrana propria.
m nt.	Mesenteries.
m nt. fil.	Mesenterial filaments.
ms d.	Mesoderm.
or.	Mouth.
or. ta.	Oral tentacles.
phx.	Pharynx.
s.	Sinistral.
sg. cav.	Segmentation cavity.
ta.	Tentacle.
v.	Ventrum, and ventral mesenteries.
v.–l.	Ventro-lateral mesenteries.

1–9. *Cerianthus membranaceus.* 1–6, 8, 9, from A. O. Kowalevsky, Observations on the development of the Cœlenterata. From the Publications of the Imperial Society of Friends of Natural Sciences, Anthropology, and Ethnography. Moscow: Katkov. 1873. (Russian.) Pl. VI.

1. Egg after the segmentation is completed. $\frac{3}{1}$. The blastoderm, of a single layer of uniform columnar cells, embraces a comparatively large segmentation cavity.
2. Stage showing the invagination of one half of the blastoderm into the other half. At the bottom of the cavity are seen fat globules (*gtt. ol.*) which came out through the invaginated cells, *en.*
3. A farther developed stage, already slightly elongated.
4. The edges surrounding the mouth-opening have been infolded to form the beginning of the stomach, *phx.*
   Note. — This infolding affects principally only two opposing sides, whereby the cavity thus formed is bounded on two sides, as shown in this figure, by both layers (*cc.* and *en.*) of the infolded wall, whereas at the two remaining sides the infolded portion of the ectoderm is in immediate contact with the superficial layer, the entoderm not being involved in the folding. The upper part of the entodermic cavity is thus divided into two lateral pockets. Compare fig. 9.
5. A still more developed stage, in which four tentacles (*ta.*) have appeared. The rim or lip which surrounds the mouth-opening is seen through the substance of a tentacle at *lab.*
6. A swimming larva of Cerianthus, which shows, beside the four tentacles, a pair of oral tentacles (*or. ta.*), a pair of mesenterial filaments, and an indication of the so-called anal pore at the aboral end.
7. Longitudinal section of a larva of Cerianthus membranaceus. $\frac{3}{1}$. From Étienne Jourdan, Recherches zoologiques et histologiques sur les Zoanthaires du Golfe de Marseille. Ann. sci. nat., sér. 6, zool., Tom. X., Art. no. 1. Pl. XVI. fig. 121.
8. Transverse section through the posterior end of the larva represented in fig. 5. The longitudinal muscles of the wall, lying on the outer margin of the membrana propria, are shown cut across at *lg. mu.* These are believed to have originated from the ectoderm. The cut ends of the longitudinal muscles on both sides the mesenteries are seen at *lg. mu′.*
9. Transverse section through the upper end of the same larva.

10–15. *Cerianthus?* (*Dianthea nobilis* Busch). From Wilhelm Busch, Beobachtungen über Anatomie und Entwickelung einiger wirbellosen Seethiere. Berlin: A. Hirschwald, 1851. Taf. XVII. figs. 1, 2, 4, 5, 7, 8.

10. Young larva, uniformly ciliate; too opaque to show internal structure.

11. More advanced stage of the same individual. To the two rudiments of tentacles which made their appearance 24 hours earlier, is now added a third, which is soon to be followed by a fourth. In swimming, the end opposite the tentacles is in advance.

12. Beside the four tentacles there is a pair of oral elevations. Compare *or. ta.*, fig. 13.

13. Oral aspect of a six-tentacle stage. The two new tentacles are *ta'.*, *ta''*.

14. A seven-tentacle stage, much contracted. The fifth tentacle (5) has reached the length of the four older ones. The sixth and seventh have both appeared in the same intertentacular space, namely, the one adjacent to the space occupied by the fifth. The oral lips show a maximum protrusion. Two of the clavate organs are pedunculate ; two, attached near the bases of the sixth and seventh tentacles, are still sessile.

    NOTE.— The tentacle marked "5" is stated by the author to be the fifth, which at this stage reaches the size of the first four. One would naturally infer that *ta'.* of fig. 13, being the larger, would be the new tentacle first to attain the size of the other four ; such however cannot be the case, since in fig. 14 the *relative position* of the fifth as compared with the sixth and seventh does not admit this conclusion.

15. Stage — about 30 days older than that of fig. 10 — with seven tentacles of equal length and four pedunculated club-shaped organs, *m nt. fil.*

16–23. *Edwardsia* (sp.?). 16–22. From Alexander Agassiz, On Arachnactis brachiolata, a species of floating Actinia found at Nahant, Massachusetts. Boston Jour. Nat. Hist., Vol. VII., pp. 525–531 and 5 woodcuts; and from drawings by Alexander Agassiz at Nahant, Sept., 1862.

    NOTE. — The natural attitude of the animal while swimming is with the tentacles down, the younger tentacles, however, being on the side nearest the surface.

16. The young larva with only four marginal tentacles, seen from the side (dorsal?) bearing the youngest pair. The two in the distance are the large pair of tentacles at the opposite extremity of the mouth-slit. The slit and the folds from which are formed the labial tentacles are seen edgewise, and there are already indications of the existence of mesenterial filaments. The large polygonal "yolk-cells" form a central mass, which slowly revolves, and is reduced in size as the larva increases in age.

17. Oral view of a larva with three pairs of tentacles, beside the odd tentacle which lies in the axis of the oral elongation and in this figure is placed below. The disk should have been represented more strongly compressed laterally. *d ?* (dorsum?) The region of the formation of new tentacles. The oral tentacles are as yet simple thickenings of the walls around the mouth, and project straight up as seen in fig. 16.

18. A later stage, seen from the edge (ventral?) which bears the odd tentacle, and showing the labial tentacles directly above the latter. A pair of mesenterial filaments and the sphere of yolk-cells are seen through the wall of the body.

19. Oral aspect of the same stage as that of fig. 18. The odd tentacle (ventral edge ?) down. The paired tentacles decrease in size toward the dorsum (*d ?*).

20. Much later stage with 13 tentacles, seen from the (dorsal?) edge which bears the youngest tentacles. The outline of the oral lips seen through the tentacles ; the odd tentacle in the distance. The mesenteries are symmetrically arranged and proportional in size to the corresponding tentacles, and the sphere of yolk-cells is much reduced in proportion to the size of the cavity.

21. View of the same from the ventral (?) edge, only one-half of the oral end being shown ; the large pair of oral tentacles quite prominent.

22. A stage less advanced than the last, seen from the left (?) side, the labial tentacles seen through the marginal ones. The "digitate appendages" (mesenterial filaments) have their convexities turned away from the odd tentacle of the ventral (') margin.

23. From a drawing of an *Edwardsia* with 16 tentacles which was raised from "Arachnactis" and drawn by Alexander Agassiz at Newport, R. I., Sept. 1872. One pair of the mesenterial filaments is much more developed than the remaining pairs. Seen from the ventral (') side.

24–33. From drawings illustrating an unpublished paper by E. L. Mark, on the development of an *Edwardsia* parasitic in its earlier stages in Mnemiopsis Leidyi, perhaps *Edwardsia linearis* Verrill. Figures 26 and 33 were drawn from living specimens toward the end of October 1882, the others, either at Newport, R. I., in August 1882, or from material collected at that time.

24. Outline of Mnemiopsis showing numbers of the parasites of various sizes grouped about the infundibulum and the beginnings of the radial canals. Many stages, and often in greater numbers, are usually to be found in a single jelly-fish. They are more or less translucent and of a delicate pinkish color.

25. One of the larger parasitic individuals, removed from the jelly-fish. $\frac{3}{1}$. The pharyngeal sac is very short and may be seen projecting inward from the truncate oral end for a little distance. The eight mesenteries, which are already formed, are not shown in the drawing. On separating from its host, the parasite contracts, though slowly, to such an extent that its proportions are about the same as those of the Cerianthus larva shown in fig. 10. In this condition it leads a free life. It swims like actinia larvæ with the aboral end foremost.

26. A later, balloon-shaped, free stage as seen swimming. The positions of the mesenteries are marked by superficial longitudinal depressions. Eight tentacles have already appeared. The cilia which cover the whole body are relatively too short to be reproduced. $\frac{1}{1}^{5}$.

27 Ventral aspect of a young parasitic stage, showing the latero-ventral mesenterial folds, which are the first to be developed. $\frac{7}{1}^{3}$. The right latero-ventral mesentery ends somewhat abruptly before reaching the aboral pole. The other mesenteries are only feebly indicated in

28. Posterior face of a cross section of the same larva near the middle of the anterior half (α, fig. 27). Depressions in the surface of the entoderm show the places where the mesenteries will appear. In this section the depressions corresponding to the dorso-lateral mesenterics (*d.-l.*) are most evident, those of the ventral pair (*v.*) less distinct, and those of the dorsal pair (*d.*) not indicated. The ventro-lateral mesenterial folds are strongly ciliate, but cilia cannot, in the sections, be seen on other parts of the internal wall. The cells of these folds are wedge-shaped-columnar in form, whereas all the rest of the inner cell-layer is of a spongy or reticulated appearance and the cell boundaries are not distinguishable. $\frac{1}{1}^{5a}$.

29. A parasitic stage somewhat older than the preceding, stained, made transparent in clove-oil, and seen from the dorsal side; magnified about 20 diameters. The edges of the ventro-lateral mesenteries are seen to be continuous with the ectodermic lining of the pharyngeal sac, and may be traced to the middle of the posterior half of the body, where they *appear* in the drawing to meet by convergence. The ectoderm is thick at both ends, but much thinner along the sides of the larva. An artificial (?) separation between ectoderm and entoderm at the oral end leaves a series of arched spaces (*cam.*) around the front end of the pharyngeal sac.

30. Cross section through the pharyngeal sac of a stage near the preceding. $\frac{7}{1}^{2}$. Although drawn from the anterior face of the section, the lithographer has reversed it, so that the effect is as though it were a view of the posterior face. The ectoderm is rather diagrammatic, the unshaded portions being intended to represent the gland-cells. The row of dots at the deep surface of the ectoderm indicates diagrammatically the enlargement of the basal ends of ectodermic cells. Similar rows of dots on one side of each of the mesenteries represent the cut ends of the longitudinal muscles of the mesenteries and are somewhat too strongly marked. The muscles are only feebly developed at this stage. Spindle-shaped nucleated cellular elements are scantily present in the homogeneous sub-ectodermal layer, as at *cl*.

31. Anterior face of the fourth section below the free end of the pharyngeal sac, from the same individual as the preceding figure. $\frac{7}{1}^{2}$. The ventro-lateral mesenterial filaments are cut obliquely, especially the one of the left side. The vacuolated nature of the entoderm is particularly noticeable when it projects, as is often the case, in thick longitudinal ridges into the common cavity of the body. These thickenings (*en'.*), although constantly occurring in all the interspaces between mesenteries, are very irregular in their dimensions. Compare figure 33, where, as is always the case with later stages, they are more conspicuous than the mesenteries themselves.

32. Anterior face of a cross section near the aboral end, from another specimen of about the same age as the preceding. $\frac{7}{1}^{2}$. The entodermic ingrowths nearly fill the digestive space, and have a peculiar zig-zag course, not well reproduced by the lithographer. This peculiar appearance results from the fact that the section is so near the aboral end as to approach the condition of a *tangential* section. The middle half of the ventro-lateral mesenteries, as well as the inter-mesenterial protrusions (*en'.*), are so thoroughly vacuolated as to present a very porous and spongy appearance which makes the histological distinction between the thickened free margins of these mesenteries (the mesenterial filaments) and the more peripheral parts of the mesenteric folds very conspicuous. This difference is intensified by the deep stain which the marginal band takes.

    NOTE.—On account of the small size of the drawing neither the vacuolation nor the structure of the mesenterial bands have been well reproduced by the lithographer.

33. Ventral aspect of a living specimen possessing sixteen tentacles arranged in two cycles of eight each, the smaller alternating regularly with the larger; magnified about 7 diameters. The transparency of the animal allows one to see the short pharyngeal sac and the mesenteries of the opposite wall, although, to avoid confusion, the latter have not been drawn. The animal is very changeable in form, the aboral end being often much more dilated than in this figure. The mantle of amorphous matter (β) surrounding the column is the product of ectodermic secretions, and forms a loose tube within which the animal may retire.

34. *Edwardsia?* From C. Claus, Bemerkungen über Ctenophoren und Medusen. Zeitschr. f. wiss. Zool., Bd. XIV. Taf. XXXVII. fig. 7. A spheroidal larva from Messina magnified about 25 diameters. The walls consist of a small-celled ciliated entoderm and an ectoderm of large cells, the two cell-layers being separated by an intervening layer of clear homogeneous substance. Two of the twelve (8?) meridional rows of large orange-yellow fat-globules are indicated by *gtt. ol.* There are four coiled tentacle-like arms (mesenterial filaments?) which may be protruded through the mouth opening.

    NOTE.— It is probable from the statements of the brothers Hertwig (*op. cit.* pp. 126, 127) that this is the young either of an *Edwardsia* or a nearly related unknown form, since it has four pairs of mesenteries with well developed muscular bands, which have exactly the same arrangement around the pharyngeal sac as in *Edwardsia*.

35, 36. *Edwardsia ?* (*Kalliphobe appendiculata* Busch.) From Wilhelm Busch, Beobachtungen über Anatomie, etc. (cited above), pp. 130–132, Taf. XIV. figs. 8, 10. Magnified about 100 diam.

35. Larva with oral end down. Into the general cavity two club-shaped organs (*m nt. fil. ?*) project. At the aboral pole there is a tuft of cilia, half as long as the body, which is only partially represented in this figure.
36. The same larva as that last figured with the club-shaped organs protruded through the mouth. The latter are ciliate, and armed with nettle-cells like the ectoderm.

37–43. *Alcyonium digitatum* Lam. From A. O. Kowalevsky, Observations on the Development of Cœlenterata (cited above). pp. 16–23. Taf. IV B. and V.

NOTE. — *Three of the earliest stages are figured at the bottom of Plate XII. figs.* 57–59.

37. The central, as well as the outer, layer has broken up into nucleated cells.
38. The larva is already formed. The limits of the inner cells and their nuclei are only very indistinctly visible.
39. (Erroneously numbered 30.) An advanced stage of a free swimming larva. The entodermic cavity is nearly filled with yolk substance (*vt.*), containing at one pole transparent vacuoles.
40. A larva which has become attached.
41. Around the infolding which was formed at the upper end there have grown out eight rounded protuberances.
42. A cross section of the preceding stage, showing the pharyngeal sac (*phr.*), the continuous layer of sub-ectodermic cells, — the middle layer (*msd.*), — and the walls of the mesenteries surrounding still persistent masses of yolk.
43. Cross section of a more advanced stage than the preceding. The remnant of the yolk (*vt.*) lines the inner surface of the entoderm, and the mesoderm (*msd.*) is composed of a double layer of spindle-shaped cells. The membrana propria is seen between the entodermic walls of the mesenteries.

PLATE XIII.

Development of Zoantharia *and* Alcyonaria *continued. Figures from* Henri de Lacaze-Duthiers, Étienne Jourdan, A. O. Kowalevsky, G. von Koch, Edmund B. Wilson, *and* R. v. Willemoes-Suhm.

cap.	Capsule.
cil.	Cilia.
coll.	Columella.
cx.	Calcareous concretions.
d.	Dorsum ; dorsal mesenteries.
d.-l.	Dorso-lateral mesenteries.
ec.	Ectoderm.
en.	Entoderm.
en'.	Thickening of *en* corresponding to the calcareous septa.
en''.	Inner layer of *en*.
e the.	Epitheca.
gtt. ol.	Oil globules.
mb. pa.	Membrana propria.
m nt.	Mesentery.
mur.	"Wall" of the calcareous cup.
ms d.	Mesoderm.
nl.	Nucleus.
nl'.	Clear space in the region of the germinative vesicle.
nll.	Germinative spot.
or.	Mouth.
pes.	Foot.
phx.	Pharynx.
p pl.	protoplasm.
py.	Primary polypite.
rch.	Rachis.
rud.	Rudimentary zoöids.
scp.	Calcareous septa.
spc.	Spiculum.
ta.	Tentacle.
ta'.	Short *ta* ; beginning of *ta*.
te.	Testis.
v.	Ventral.
vit.	Vitellus.
z d.	Zoöid.
z d'.	Median (or "Haupt") zoöid.

1–11. *Astroides calycularis.* From Lacaze-Duthiers, Développement des Coralliaires. Deuxième mémoire. Actiniaires à polypiers. Arch. de Zool. exp. et gén., Tom. II. 1873. Pls. XII–XV.

Note. — The sequence of the stages is indicated by the following order of the figures : 1, 6, 9, 5, 7, 2, 3, 4, 10, 11, 8.

1. A free-swimming larva with strongly expressed spiral form, which it assumes when in motion. The arrow indicates the direction of the motion, the aboral end being in advance.
2. Oral aspect of a larva with 12 mesenteries. The twelve lobes thus formed are divided by the first pair of mesenteries, as in Actinia (see Plate XI. figs. 12–16), into two groups of 7 and 5 respectively. The order of succession of the mesenteries is the same as for Actinia.

   Note. — It will be seen by comparison that the 5th and 6th are transposed, as compared with Actinia !
3. Oblique view of the aboral end of the same larva.
4. A more advanced larva than the preceding. After having begun, while in the free state, the formation of calcareous nodules in its tissues, it is now attached, and tentacles have made their appearance.
5. The embryo begins to undergo a modification of form. The mouth (*or.*) is seen at the summit of an elevation surrounded by the peristome ; the foot is relatively reduced in size.
6. The same larva as seen in figure 1. Granules are seen escaping from the mouth, which is placed above.
7. Side view of an embryo which has attached itself to the microscopic slide.
8. View of the base of a specimen in which the calcareous septa are forked at their peripheral ends, the tines of the forks being short. The mural (epithecal ?) layer (*e the.*) is already formed, but the septa are not yet joined to it.
9. An embryo slightly compressed ; before compression the surface showed no trace of a striation, although the walls of the body had advanced into the cavity and very young mesenteries were already developed. The distinction between the inner and outer layers is evident.

10. A young polyp perfectly developed, having two cycles of tentacles. At the base the wall (*c the.*) limiting the cup of the young polyp has already become very evident.
11. The internal (entoderm) and external (ectoderm) layers are sharply marked. The elongated calcareous nodules indicate the points of origin of the septa. The three centres of deposit for each septum are located not in the external but in the internal (entodermic) layer. (Compare Koch's results, below, figs. 18–28.)

12–15. *Balanophyllia regia.* From É. Jourdan, Recherches zoologiques et histologiques sur les Zoanthaires du Golfe de Marseille. Ann. sci. nat., sér. 6, zool., Tom. X., Art. no. 1. Pl. XVII. figs. 123, 124, 126, 127.

12. Vermiform larva. $\frac{9}{1}$.
13. A more advanced larva. $\frac{9}{1}$.
14. Longitudinal section of a larva of the same stage as the preceding.
15. Transverse section of a larva having six mesenterial plates. *ms d.* The mesoderm in process of formation. $\frac{3}{1}^{0}$.
16. Note. — Figures 16 and 45 have been transposed by the lithographer. For the explanation of figure 16 see below.

45, 17. *Astræa* (sp.?). From A. O. Kowalevsky, Observations on the development of the Cœlenterata. From the Publications of the Imperial Society of Friends of Natural Sciences, Anthropology, and Ethnography. Moscow: 1873. (Russian.) Plate V. figs. 15, 17.

45. Longitudinal section of the large, ciliated, brick-red larva. The central mass (*vt.*), evidently derived from cells, is now composed only of nuclei (*nl.*) and oil globules (*gtt. ol.*). The entoderm (*en.*) of the present stage forms only *a part* of the many-layered entoderm of the fully developed polyp, the balance being derived from this central mass.

    Note. — The dotted line from *en* should not have been carried as far as the central mass, but should have ended in the layer of columnar cells separating the ectoderm from the central mass.

17. View of the larva from the oral end after it has become attached and flattened. *tnl.* The rudiment of a tentacle. The radial or intermesenterial chambers (*r. cam.*) appear as transparent cavities.

    Note. — The central ends of the mesenteries bounding all the chambers except two are grouped in pairs, and in such a way as to make the whole appear symmetrically divided by the line η. That this line cannot, however, represent the projection of the plane of bilateral symmetry, is very evident from the studies of other observers.

18–28. *Asteroides calycularis.* From G. von Koch, Ueber die Entwicklung des Kalkskeletes von Asteroides calycularis und dessen morphologischer Bedeutung. Mittheilungen aus der Zoologischen Station zu Neapel, Bd. III. 1882. Taf. XX., XXI.

18. Somewhat more than one-half of a radial section of a young larva, killed the last of June, which had attached itself to cork (θ). The first trace of the skeleton lies between ectoderm and cork in the form of small, more or less fused, calcareous concrements, *cx.* The section along the floor passes longitudinally through the entodermic thickening (*en'.*) corresponding to the place subsequently occupied by the calcareous septa (compare figs. 19 and 20, *en'.*, *scp.*). $\frac{1}{1}^{0}$.
19. Portion of a section from the same individual, parallel to the preceding section, but distant from the centre. Three mesenteries (*m nt.*) and two of the entodermic thickenings (*en'.*) are cut transversely. The beginning of the skeleton (*cx.*) is also to be seen below the ectoderm. $\frac{1}{1}^{0}$.
20. Portion of a section similar to the preceding, through an older individual. One mesentery with a median layer of connective substance (mesoderm, *m sd.*), flanked on either side by entoderm, is cut across, as are also two calcareous septa (*scp.*), continuous with the floor-skeleton. $\frac{7.5}{1}$.
21. Marginal portion of a section from an individual killed in the middle of July. To show the formation of the epitheca (*cx.*). $\frac{1.5}{1}^{0}$.
22. A small portion of the base from the section shown in fig. 18, more highly magnified. The entoderm is vacuolated and contains nuclei. The mesodermic connective tissue is scarcely discernible (not well reproduced in the lithograph). The ectodermic cells are nucleated and have sharp contours, especially at their free ends. The calcareous concretions (*cx.*) are very small spheroids and double spheroids which lie between the free ends of the ectodermic cells and the cork.
23. A portion of the preceding still more magnified, and giving a better idea of the form of the concretions and their relations to individual cells.
24. The cells of the ectoderm from another part of the same section, together with a calcareous concretion.
25. A stage somewhat older than that (compare figure 8) in which the septa remain separate. The latter have acquired by their lateral outgrowths a complicated form. A portion of them have fused with each other at the periphery to form the first trace of the mural layer (*mur.*); in the centre also several have joined their fellows. A narrow rim of epitheca (*c the.*) is already formed, but remains distinct from the mural layer.

26. The oldest stage raised artificially; near the end of October. Six of the calcareous septa overtop the other six, and a new series of 12 additional septa is faintly indicated; the columella (*coll.*) is already formed. This individual is distinguished by a very considerable development of the epitheca. $\frac{3}{4}$.
27. A much further developed stage, nearly 2 mm. high. There are 24 septa which fall into three orders according to their relative sizes. The epitheca is not visible, as it does not reach to the margin of the cup. $\frac{3}{4}$.
28. Almost fully developed single individual with 48 septa, 12 of which overtop the others.
Subsequently 48 new septa, alternating with those already formed, make their appearance, and the main septa are at the same time increased in number from 12 to 24.

29–42. *Corallium rubrum*. From Lacaze-Duthiers, Histoire naturelle du Corail, etc. Paris: 1864. Pls. I., II., XI., XIV., XV., XVII–XIX.

29. One of the many forms assumed by the ciliate larva in its natural position, with the mouth-end downwards.
30. Another, more worm-like form of the ciliated larva (compare corresponding stage of Astroides, fig. 1).
31. One of the stages of transformation from the worm-like to the disk-like form. The aboral region becomes enlarged, and the oral end sinks in.
32. An expanded "oözoite" (animal developed from an *egg*) attached to a rock; the latter not reproduced here.
33. An oözoite still older than the preceding, though still simple. Expanded and seen from the oral side.
34. The same oözoite seen in fig. 32, but in a contracted condition.
35. One of the tentacular arms of the adult, seen in profile. In this position the barbules are seen to be directed obliquely from above downward, and from within outward.
36. Oral view of a larva several days after its metamorphosis. The central part around the mouth (ι) is already elevated and forms a *bourrelet;* the base is not so regularly circular as it was at first, since it commences to spread itself over the body to which it is attached.
37. Extremity of a barbule from a tentacle of an adult, magnified 250 diam. *ec.* External cell-layer. *en.* Large cells forming a network and bearing vibratile cilia.
38. Spicules which are exposed on tearing away the epidermis from the adult.
39. Nematocysts from the adult; one with the mother-cell still surrounding the nematocyst — or internal capsule — with its spiral filament.
40. Portion of a radial fold (mesentery, *m nt*) bearing (1) at *ov.* an egg, the capsule (*cap.*) of which has in part fallen away, and the vitellus (*vit.*) of which presents a very distinct clear spot (*nl'*), corresponding to the transparent (germinative) vesicle, in the middle of which are to be seen the germinative spots (*nll.*); (2) at *te.* a capsule in process of development, remarkable on account of an apparently empty space (λ) surrounded by a cellular band (κ) which lines the capsule; this is a testicle.
41. A small rock to which are attached three zoanthodemes, the polyps of 2 and 3 having been destroyed. 3. The beginning of the corallum; a plate with irregular sides covered here and there with small projecting corpuscles bristling with points. 2. Exhibits an early form of the corallum. It consists of an irregular plate, curved into the shape of a horse-shoe, formed of masses of agglomerated spicules. The general cavity of the body of the polyp occupies the interior of this curve, and consequently the solid plate is formed, as may be seen at 1, in the midst of the sarcosoma between the external and the internal surfaces.
42. Zoanthodeme composed of one oözoite (1), and three "blastozoites" (budded individuals), 2, 3, 4.

43, 44, 46. *Gorgonia verrucosa*. From G. von Koch, Vorläufige Mittheilungen über die Gorgonien (Alcyonaria axifera) von Neapel und über die Entwicklung von Gorgonia verrucosa. Mittheilungen aus der Zoologischen Station zu Neapel, Bd. III. 1882. Figs. 10, 13, 15.

43. Section through an egg before the segmentation spheres have been differentiated into distinct layers. The outer cells are somewhat smaller than the inner, and all possess distinct nuclei. The latter appear to be wanting in some of the cells simply because lying outside the plane of section.
44. Longitudinal section of an attached individual, showing the thin layer of ectoderm infolded to form the pharyngeal sac which opens into the entodermic cavity below.
45. Note. — Figures 45 and 16 have been accidentally transposed by the lithographer. For explanation of 45 see above.
16. *Gorgonia verrucosa*. From A. O. Kowalevsky, Observations on the development of the Cœlentrata (cited above). Taf. V. fig. 19. Ciliated larva. There are to be distinguished two layers in the entoderm. The peripheral layer (*en.*) is striate, indicating its composition out of cylindrical cells, with irregularly arranged nuclei; this merges into the inner layer (*en'.*) which is granular, filled with highly refractive spherules, and is ciliate. (The cilia are not figured by the author.) The latter is considered equivalent to the yolk-mass of Alcyonium and of Astræa.
46. Four cells of the ectoderm, one of which has migrated into the underlying mesodermic layer (*Zwischensubstanz*) and shows at one side of its nucleus the cross section of a spiculum which is being formed within it. The same cell somewhat more enlarged is figured near by.

47–52. *Renilla reniformis* Cuv. From E. B. Wilson, The Early Stages of Renilla. American Journal of Science, ser. 3, Vol. XX. 1880. Pl. VII.

47. Young, bilaterally symmetrical, ciliated, free-swimming polyp with the first pair of zoöids (*z d.*). Of the septa (mesenteries), the dorsal pair (*d.*) extends back as far as the zooids, the dorso-lateral (*d.-l.*) pair reaches the posterior end of the body, the ventro-lateral is somewhat longer than the dorsal, and the ventral pair is the shortest of all.
48. Later stage with 8 pinnate tentacles, probably about 2 weeks after the abandonment of the free mode of life. A third zoöid (*z d'.*) has appeared in the median line on the dorsum, in front of the two first zoöids. It is the "*Hauptzooid*" of the German writers.
49. A much later stage. The first pair of lateral zoöids (1.) now have well-developed tentacles. The order of appearance of the paired zoöids, which develop into sexual zoöids, is indicated by Arabic numerals. There are, in addition, three (usually there are 2 pairs) rudimentary zoöids opposite the bases of the first pair.
50. A much later stage than the preceding, in a state of contraction. The primary polypite (*py.*) has its oral extremity at the edge of the disk, and not yet turned upward. Subsequently this and all the marginal zoöids are forced upward and made to occupy the upper surface of the disk by the union, behind (below) them, of the younger zoöids which bud out from the angles between them and increase in size. The rudimentary zoöids bud in a similar manner, each group becoming a kind of miniature of the whole colony.
51. An enlarged view of one of the simple zoöids of fig. 50. The small ventral chamber is always turned toward the centre of the disk, that is, *away* from the oral extremity of the sexual zoöid on which it is situated.
51ª. A more advanced condition than that of the previously figured zoöid. The rudiment of a new zoöid (*z d'.*) has appeared on the upper side.
52. This new zoöid is fully developed, and two lateral zoöids (1, 1) have appeared.

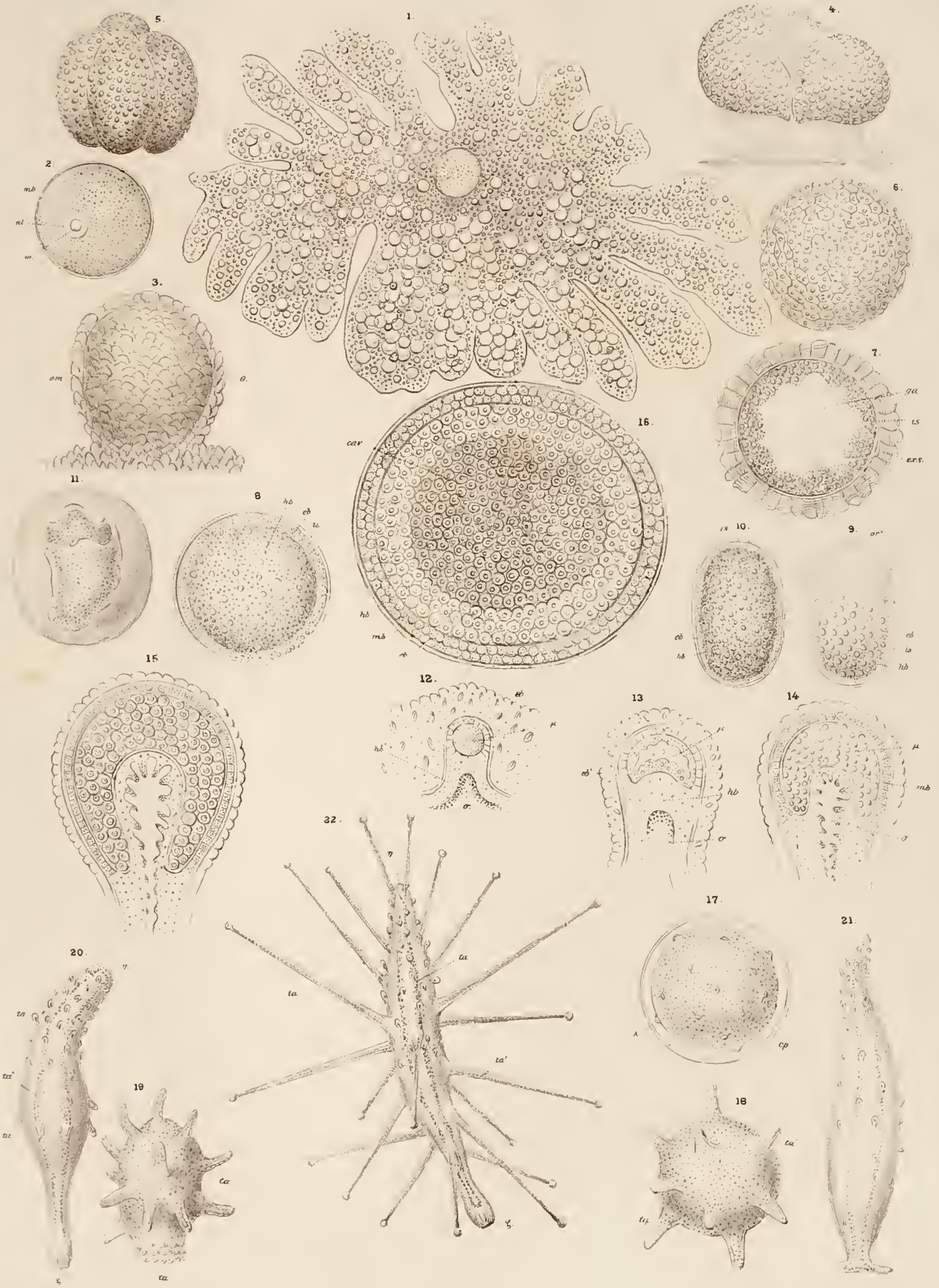
53–56. *Umbellularia* (sp.?). From R. v. Willemoes-Suhm, Notes on some Young Stages of Umbellularia, and on its Geographical Distribution. Annals and Magazine of Natural History, ser. 4, Vol. XV. 1875. Pl. XVIII A.

53. Young stage seen from the ventral side. The terminal polypite (*py.*) probably comes out first, as it exceeds the others in length. In this and succeeding figures the order of the appearance of the polypites is indicated by Arabic numerals. The rachis is shown as seen in a specimen rendered transparent. Reduced to one half natural size.
54. Another and older specimen seen from the dorsal side. A fourth polypite has appeared by the side of the original terminal polypite and has overtaken it in size, so that there are now two terminal polypites of equal size but different age, and two lateral polypites (1, 1) behind them. In addition, a fifth (3) has made its appearance in the middle of the dorsum. The zoöids appear first on the ventral side as seen in
55. A ventral view of the same specimen as the preceding, the zoöids being indicated by dots.
56. Dorsal aspect of a larger specimen in which the primary polypite (*py.*) is supplemented by another terminal one. The author does not distinguish between them, but the figures seem to warrant the interpretation given by the lettering here adopted. There is a median line along the dorsum which is destitute of zoöids.

57–59. *Alcyonium digitatum* Lam. From A. O. Kowalevsky, Observations on the development of Coelenterata (cited above). Taf. IV B. Figs. 1, 3, 4.

57. Section of the egg, in which may be distinguished a peripheral layer of finely granular protoplasm (*p pl.*) and a central mass containing yolk spherules (*vt.*).
58. Protuberances of the finely granular protoplasm of variable size appear as the first indication of segmentation. These are gradually constricted off from the central mass which they then envelop as an irregular layer.
59. This peripheral layer of cells undergoes further division. Some of the cells contain two nuclei (*nl.*), and a deep layer (*en.*) begins to be formed. Gradually there is formed from the outer layer a continuous envelope of ectodermic cells, and the whole central mass breaks up into larger nucleated cells, as seen in fig. 37, Pl. XII., which, with succeeding figures, continues the illustration of the development of Alcyonium.

INDEX.



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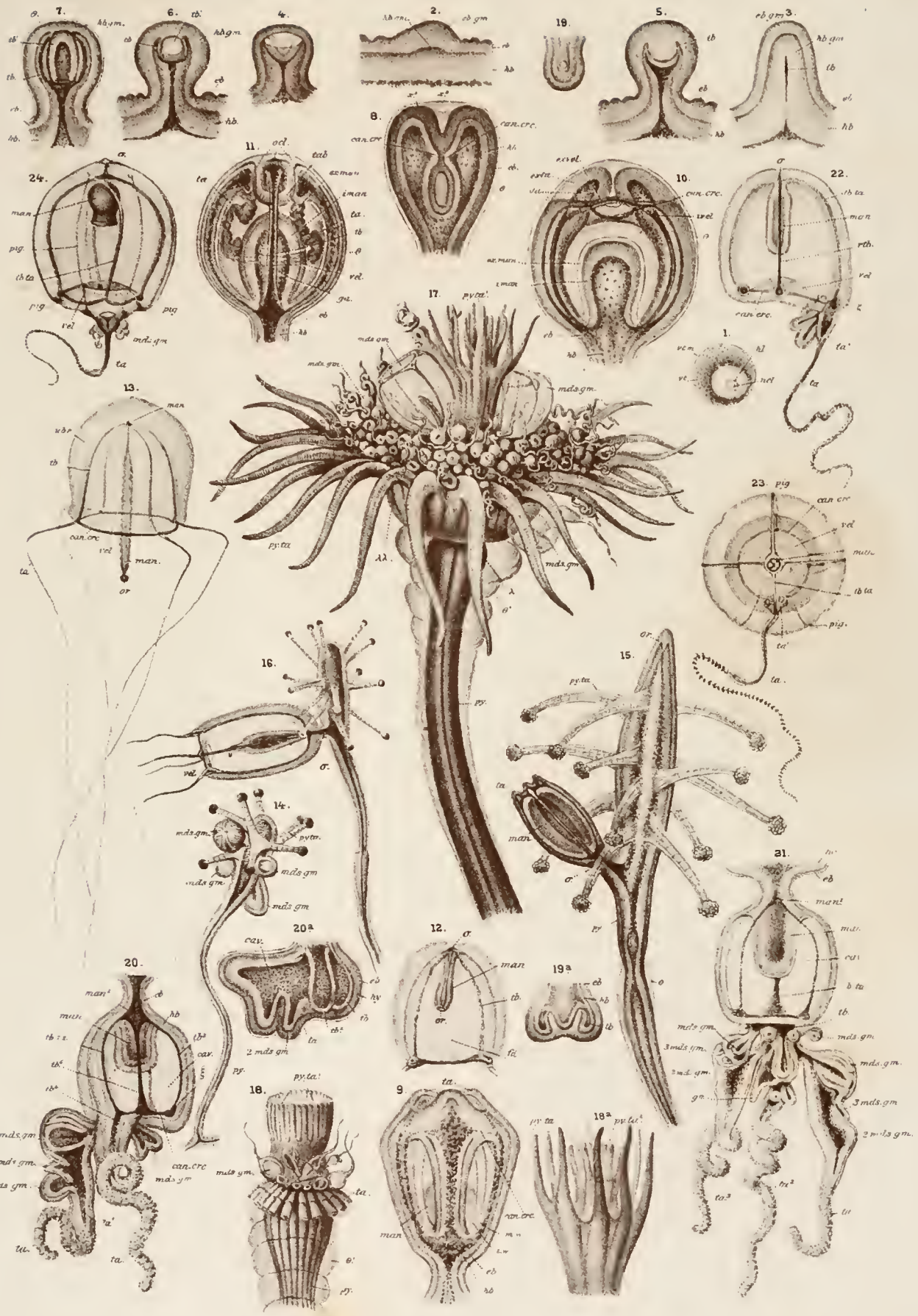

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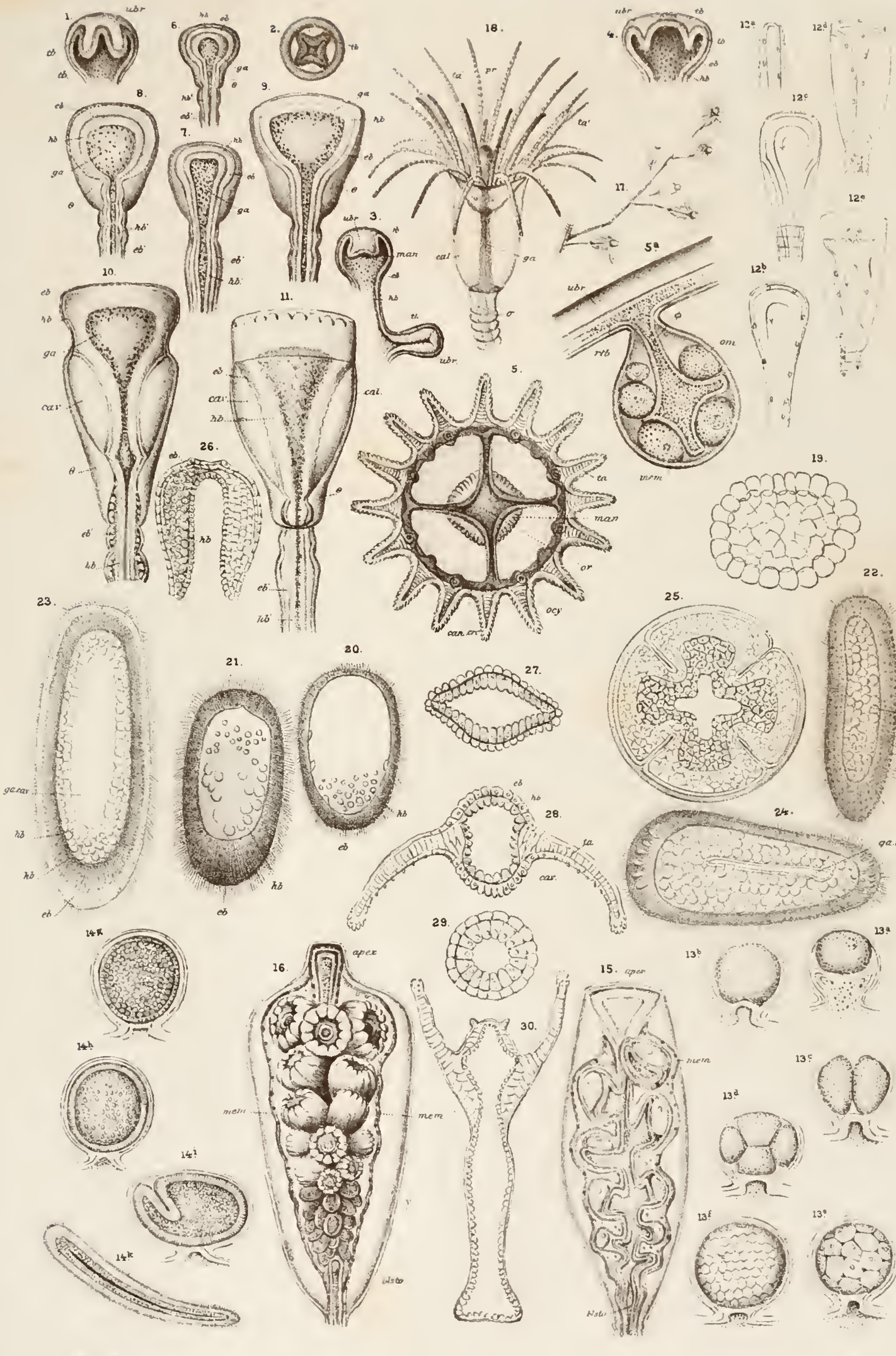
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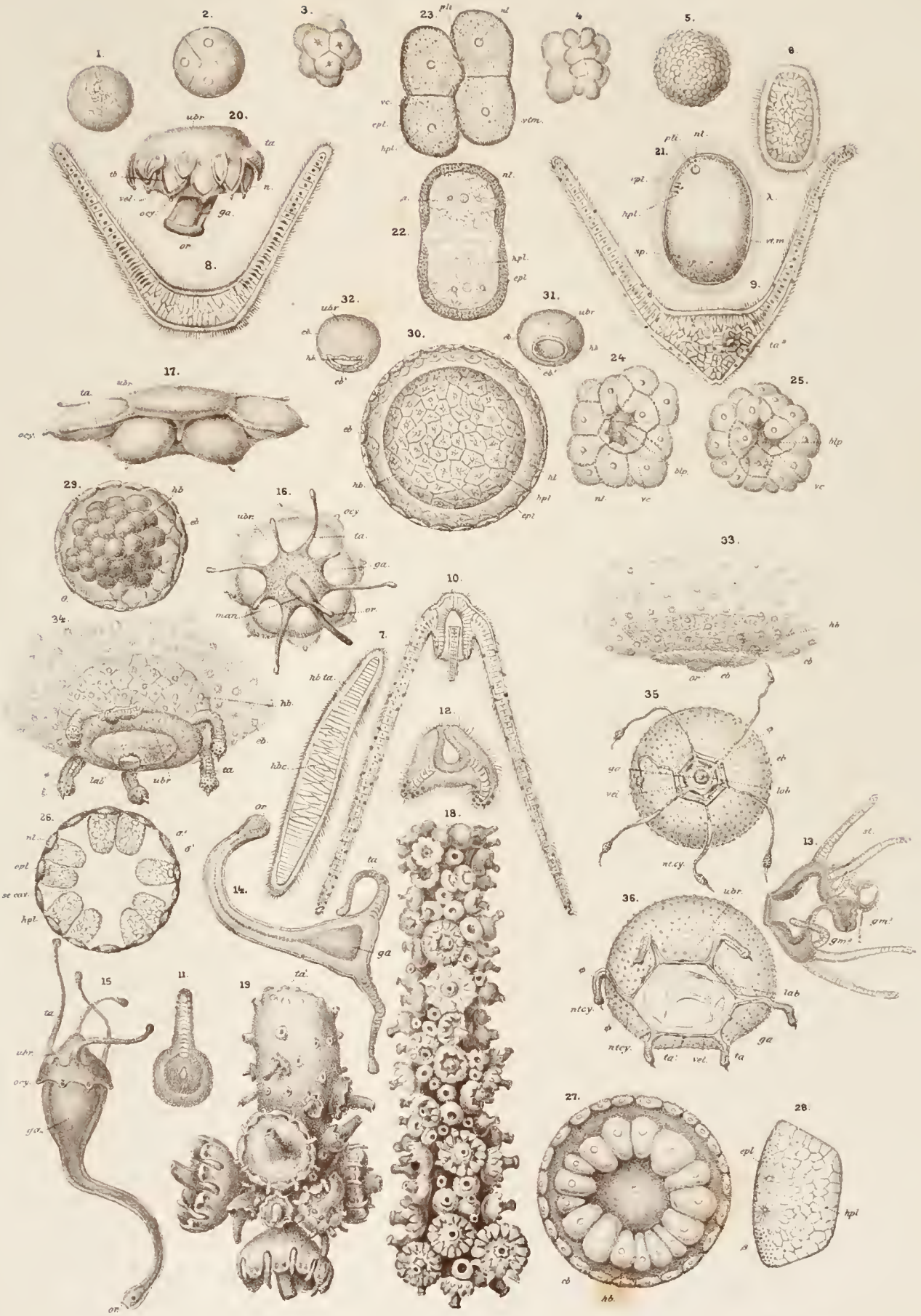
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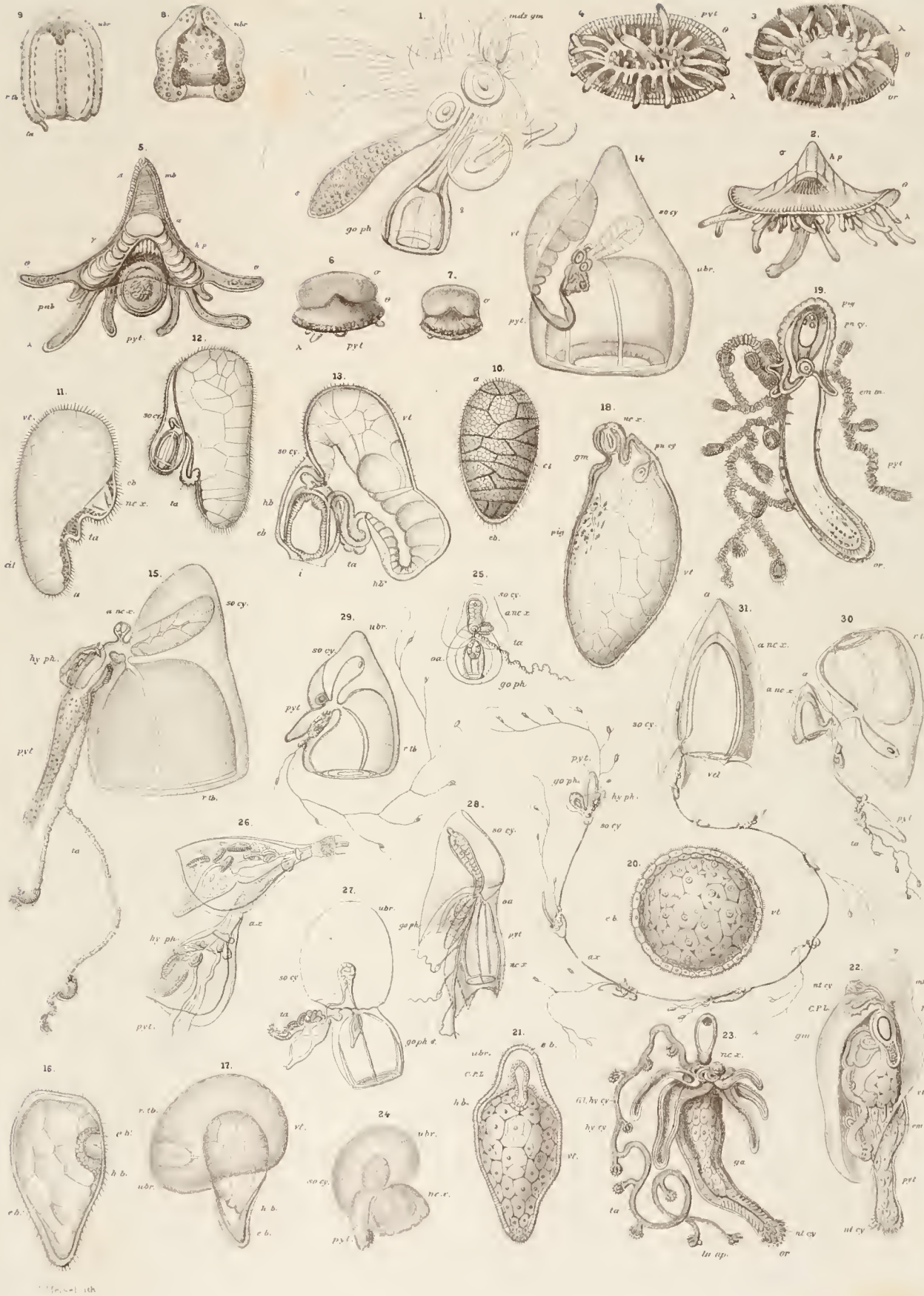
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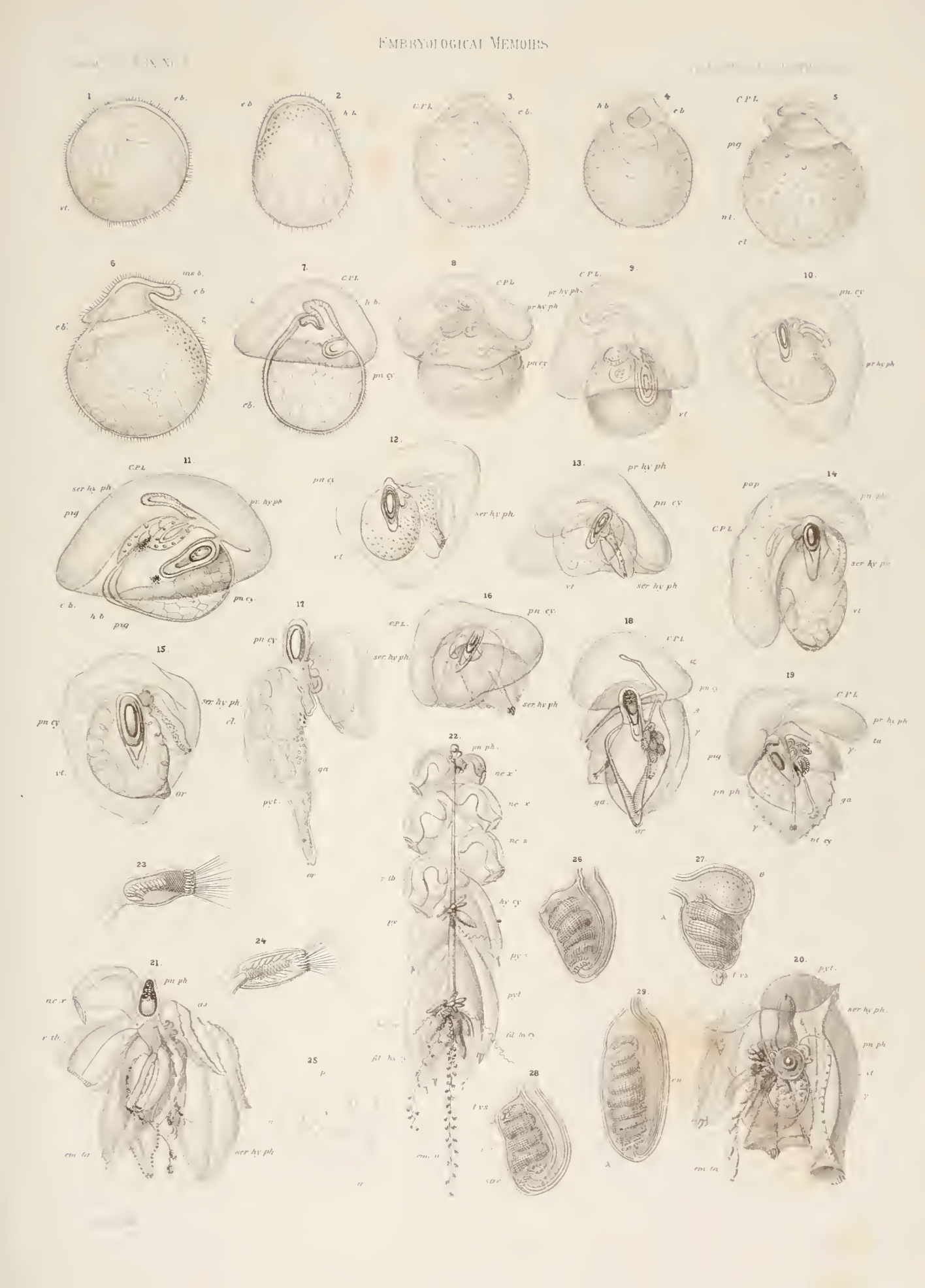
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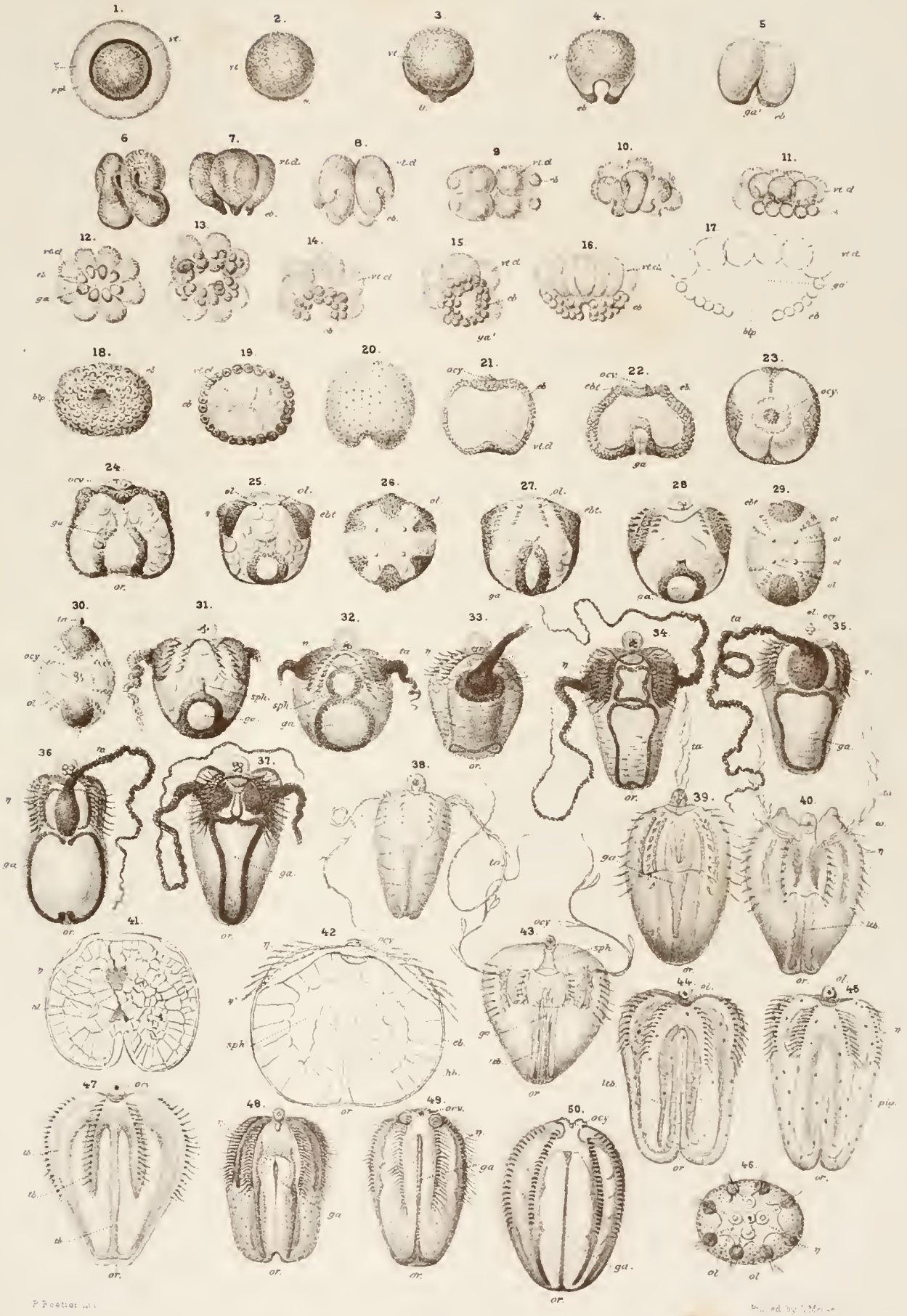
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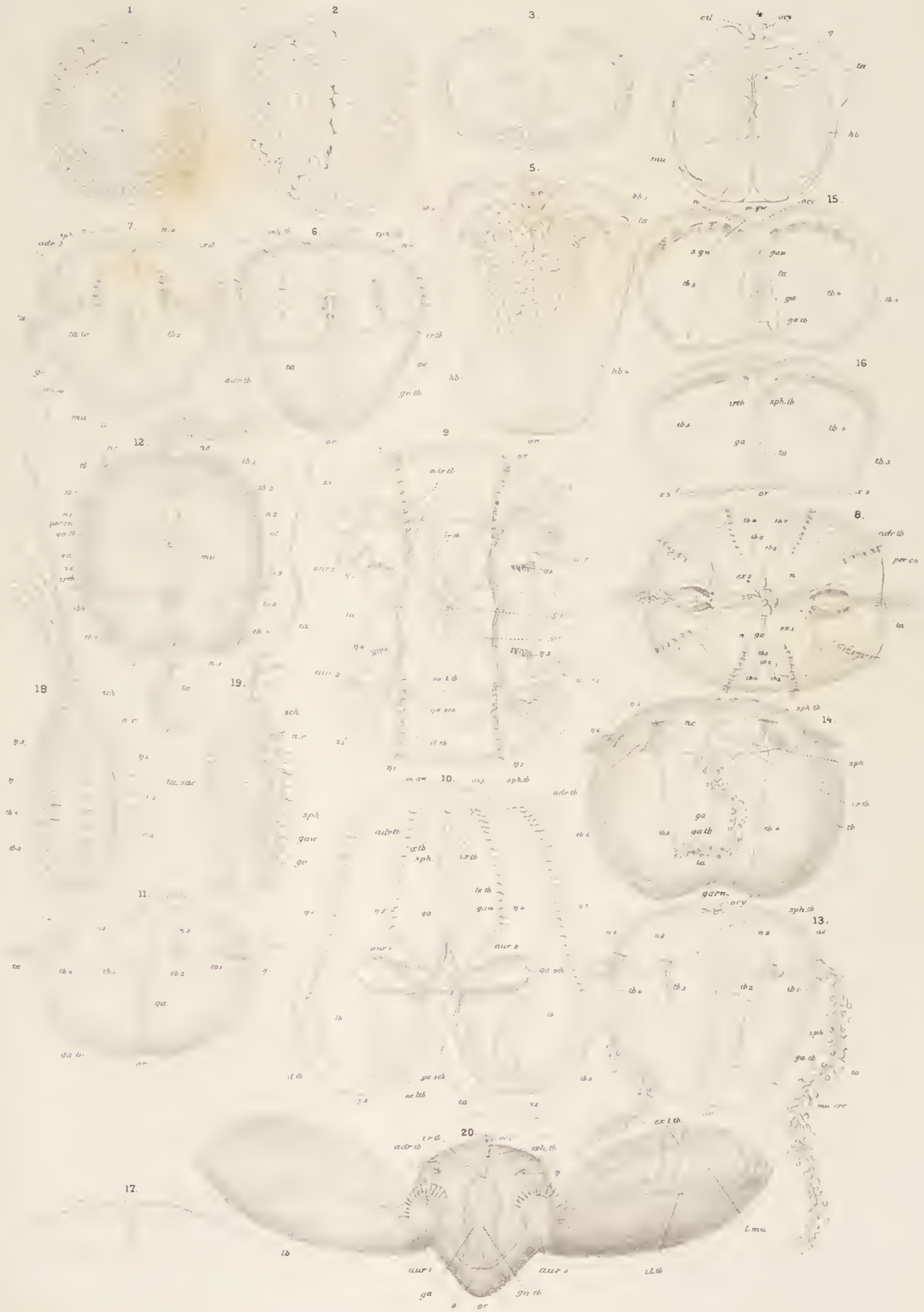
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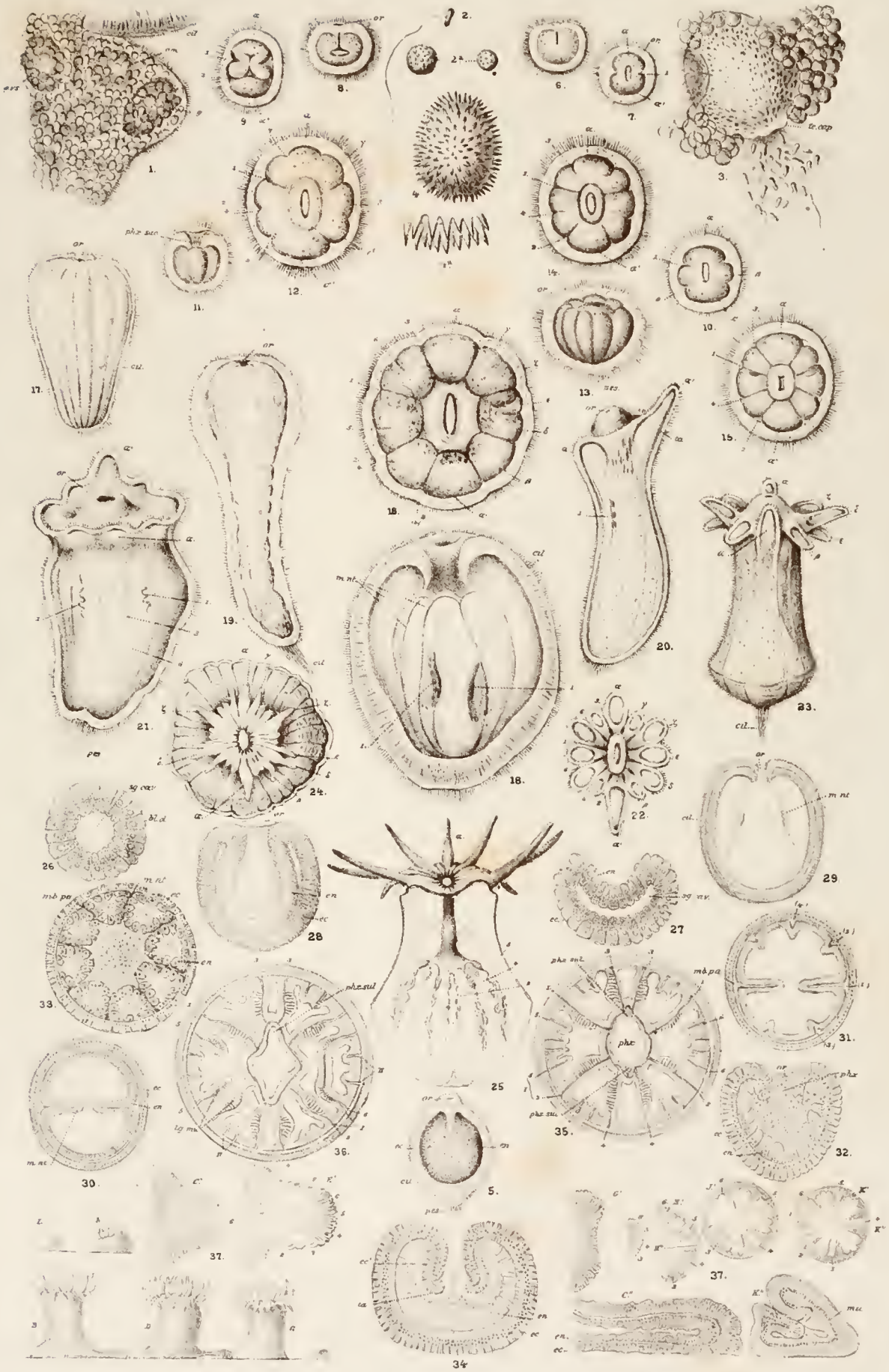
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